PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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RELATED SUBJECTS CONTAINED IN SECTION B (ELECTRICAL ENGINEERING ABSTRACTS)

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Industrial radiography
Corrosion
Electrical and magnetic measurements and instruments
Electronic relays and counters
Automatic control mechanisms
Electrochemistry
Photocells
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Induction accelerators
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Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, " : " e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

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NOTE ON THE UNIVERSAL DECIMAL CLASSIFICATION SYSTEM

The complete Tables of the 4th International Edition of the Universal Decimal Classification, used in *Science Abstracts*, are in process of publication by the British Standards Institution as B.S. 1000. The following brief notes, published with the permission of the Fédération Internationale de Documentation (F.I.D.) and of the B.S.I., may serve as a preliminary guide for readers.

The system is based on the conception of the whole of human knowledge as unity, divided into ten domains represented by decimal fractions:

.0	Generalities
.1	Philosophy
.2	Religion
.3	Social sciences
.4	Philology
.5	Pure science
.6	Applied science
.7	Art
.8	Literature
.9	History and geography

On this foundation the system is constructed on the principle of proceeding from the general to the more particular by continued subdivision of the numbers into decimal fractions.

Thus every concept within the domain of Pure Science is represented by a decimal fraction greater than .5 and less than .6, the first groups being

.50	General works on pure science
.51	Mathematics
.52	Astronomy
.53	Physics
.54	Chemistry. Crystallography
.55	Geophysics
.56	Palaeontology
.57	Biology
.58	Botany
.59	Zoology

For convenience the first decimal point is always omitted, but it is essential that it should remain imprinted on the reader's mind. The fact that all the numbers are in reality decimal fractions less than unity determines the arrangement of the numbers in numerical sequence. Thus 526 (meaning .526) precedes 53 (meaning .53) in ascending order.

To indicate a work dealing with two or more subjects independently, the numbers corresponding to these subjects are connected by + signs. Thus

531.754 + 536.62	Measurement of density and of specific heat

More important, and more widely used, is the symbol denoting some functional relation between two or more concepts, expressed by the respective numbers linked by the colon sign " : "

Thus

537.531	X-rays
535.4	Diffraction
548.0	Crystals
537.531 : 535.4 : 548.0	X-ray diffraction by crystals

Further symbols, for the use of which the reader is referred to B.S. 1000, Vol. 1, Part 1, may be used for indicating form, place, language, etc., e.g.

historical:	538.7(09)	Early geomagnetic nstruments
place:	551.524.2(73)	Temperature maps of the United States
language:	548.55 = 3	Monocrystalline tungsten wires (in German)

The arrangement in each monthly issue is numerical, according to the U.D.C. numbers. Cross-references, indicated by compound numbers linked by the colon symbol, are given in their proper places, according to each component number. Thus abstracts with compound indices such as

537.531 : 535.4 : 548.0	X-ray diffraction by crystals

are given under 537.531 X-rays, and quoted again under 535.4 Diffraction, and 548.0 Crystals, so that the subject of the abstract is indicated to the searcher in every one of the three fields.

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51	Mathematics
52	Astronomy. Geodesy
53	Physics
54	Chemistry
55	Geology. Geophysics
57/59	Biological Sciences
61	Medical Sciences
66/68	Industrial Technology
77	Photography

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51 MATHEMATICS

11	ARITHMETIC AND THEORY OF NUMBERS
11.1	Numeration. Arithmetical operations
.11	Notation
.12	Addition, subtraction, multiplication and division of integers
.13	Factors. Fractions. Decimals. Percentages. Proportion
.14	Extraction of roots. Surds. Imaginaries
.15	Arithmetical use of logarithms
.16	Operations with concrete units
.2	General properties of numbers. Residues
.22	Congruences. Indeterminate analysis of the first degree
.23	Quadratic residues
.24	Complex numbers of the form $a + b\sqrt{-1}$
.28	Theory of prime numbers
.4	Forms. Systems of forms
.5	Indeterminate equations of order higher than the first
.6	Algebraic numbers
511.7	Theory of continued fractions
.8	Transcendental numbers
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.14	Binomial formula. Powers of polynomials
.2	Equations and functions of the first and second degree
.3	Theory of equations. Polynomials
.4	Solution of equations by radicals
.5	Rational fractions. Interpolation
.8	Higher algebra
.83	Determinants. Matrices
.86	Linear substitutions. Groups See also 519.4 Theory of groups
.87	Elimination
.88	Invariants and covariants
.89	Theory of forms
.9	Universal algebra. Complex quantities. Vector algebra For differential vector operators see 517.43

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.01 Axioms
.02 Analytical treatment
.03 Infinitesimal methods
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.11/.15 Triangles
.17 Anharmonic ratio. Homography. Harmonic division. Involution
.18 Quadrilaterals
.19 Polygons
.21/.28 Circles
513.3 **Solid geometry**
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.34 Polyhedrons
.43 Right cylinder and cone
.44/.47 Spheres. Spherical geometry
.49 Geometrical constructions
.51/.55 Conics
.56/.58 Quadrics
.59 Quadric varieties
.61 Algebraic plane curves
.62 Algebraic surfaces
.63 Algebraic skew curves
.64 Transcendental curves and surfaces
.65 Algebraic twisted curves
.66/.67 Algebraic varieties of order greater than 2
.71 Complexes and congruences. Line geometry
.72 Connexes. Systems of curves, of surfaces and of varieties. Enumerative geometry
.73/.74 Infinitesimal geometry. Kinematic geometry. Trajectories
.75/.77 Transformations
.8 **Various geometries**
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.82 Multidimensional geometry
.83 Analysis situs. Topology
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515 **DESCRIPTIVE GEOMETRY. PROJECTION. PERSPECTIVE**
516 **ANALYTICAL GEOMETRY. CO-ORDINATES**
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517.26 Taylor's and Maclaurin's series
.3 Integral calculus
.4 Functional determinants. Differential forms. Differential and integral operators
517.5 **General theory of functions**
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.512.3 Series of Legendre polynomials
.512.4 Series of Bessel functions
.52 Infinite series. Convergence. Summation
.53 Analytic functions of a complex variable
.54 Conformal representation
.55 Functions of several complex variables
.56 Algebraic, circular, exponential, hyperbolic and other functions
.6 Definite integrals
.61 Gamma functions
.63 Laplace transformations
.7 Elliptic functions
.8 Hyperelliptic functions. Abelian functions. Fuchsians
.9 Differential, integral, functional and finite-difference equations
.949 Theory of finite differences
518 **GRAPHS. METHODS OF CALCULATION. NOMOGRAPHY. TABLES. MATHEMATICAL GAMES AND RECREATIONS**
519 **COMBINATORY ANALYSIS. MATHEMATICAL STATISTICS. CALCULUS OF PROBABILITY. CALCULUS OF VARIATIONS. THEORY OF GROUPS. THEORY OF AGGREGATES**
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.21 Calculus of probability
.24 Analysis of statistical data. Means. Standard deviation. Skewness
.25 Statistical regularity. Errors of observation. Probable values
.26 Qualitative observations. Contingencies
.27 Quantitative observations. Sampling. Correlation
519.3 Calculus of variation
.4 Theory of groups, fields and ideals
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.5 Theory of aggregates
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52 ASTRONOMY. GEODESY

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.04 Astrochemistry
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.14 Shape of celestial bodies
.15 Rotation of celestial bodies
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526.1 Theory and determination of the shape of the Earth
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.9(4/9) Topographical survey of different regions

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Special Analytical Subdivisions

a the section 53 Physics, special analytical subdivisions be used where no appropriate main subdivisions st, as follows:—

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.02 General laws
.03 Production and causes of the phenomenon
.04 Effects
.06 Application
.07 Apparatus
.08 Measurements
.081 Units. Constants. Dimensions
.082/.083 Principles and methods of measurement
.084/.087 Instruments and apparatus. Recording
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.39 Special problems of dynamics
.4 Work. Friction

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.51 : 530.12 Relativity theory of universal attraction
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.73 Volume
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.76 Time. Velocity. Acceleration
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525.2 Physics of the Earth

ATOMS. MOLECULES

Kinetic theory of solids
Structure of molecules
Intramolecular mechanics. Quantum theory of molecules
Molecular dimensions. Moments
Structure of atoms
Nucleus. Quantum theory of nucleus
Distribution of electrons. Quantum theory of the atom
Atomic constants. Nuclear charge. Moments
Atomic weight
Isotopes
Number of molecules in gram-molecule
Intra-atomic mechanics
Radioactivity
Measurements of radioactivity. Ion counter. Cloud chamber
Radioactive elements
Spectra. Range. Absorption
Alpha rays
Beta rays
Gamma rays
Artificial disintegration of atoms. Artificial nuclear transmutation
Rays of uncharged particles
Molecular and atomic beams
Neutrons

STRUCTURE OF MOLECULAR SYSTEMS

Surface texture
Amorphism
Plasticity
Pulverulence. Graininess
Schistosity. Lamellar structure. Fibres
Porosity. Permeability
Thin films
Microstructure
Properties revealed by the ultramicroscope
Properties revealed by X-rays. X-ray examination
Elasticity. Deformation
Theory. Internal stresses
Elastic moduli
Deformation in general
Causes of deformation. Yield point. Elastic hysteresis
Strength
Resistance to elastic deformation
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Mechanical effects of physical phenomena
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.128 Catalysis
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.18 Colloids
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.2 Atomic theory
.4 Chemical combination. Compounds
.5 Valency. Bonds
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.62 Isomerism
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547 **ORGANIC CHEMISTRY**
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.5 Growth of crystals
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.34 Seismology
.36 Terrestrial thermodynamics
.37 Terrestrial electricity
.38 Terrestrial magnetism
.4 Geochemistry
.8 Applied geology. Prospecting
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.1 General structure of the earth
.2/.3 Geodynamics
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MATHEMATICS 51

2.94 : 530.12 1

Application of quaternions to Lorentz transformations. IRAC, P. A. M. *Proc. R. Irish Acad. A*, **50** (*No.* 16) 1–70 (1945).—An attempt is made to connect uaternions with the physical world by subjecting em to a group of transformations equivalent to the orentz group, namely

$$q^* = (aq + b)(cq + d)^{-1}$$

he results are described geometrically: any transrmation of the type mentioned generates in a 5-mensional projective space a linear transformation hich leaves invariant a certain quadric. This group more general than the Lorentz group and, to obtain e latter, restrictions are imposed on a, b, c and d. his amounts to taking the subgroup given by

$$q^* = (aq \pm \mu a)(-\mu aq \pm a)^{-1}$$

here a is an arbitrary quaternion and μ is a purely naginary quaternion. An application is made to the ddition of velocities. L. S. G.

17.512.2 : 621.317.757 : 518.5 *see Abstr.* 7

17.512.2 = 5 2

An extension of Fourier's integral. WAGNER, K. W. *lta Frequenza*, **10**, 195–214 (*April*, 1941) *In Italian.*— y variation of the path of integration of the spectral ensity integral in the representation of an arbitrary unction by Fourier's integral, the spectral resolution ay be variously effected. As examples, resolutions nto harmonic oscillations of increasing amplitudes, amped harmonic oscillations, modulated harmonic scillations, are derived. V. C. A. F.

17.514.3 : 621.396.611.4 3

On the spherical and spheroidal wave functions. YDBECK, O. E. H. *Trans. Chalmers Univ. Tech. othenburg* (*No.* 43) 32 *pp.* (1945).—Various analytical roperties of the functions are investigated; these are seful in application to radio-wave propagation roblems and cavity resonators. An example given elates to the effect on waves in a circular guide of a light departure from strict axial symmetry. The esonant frequencies of a prolate ellipsoidal cavity esonator are investigated. [See Abstr. 1430 (1935), 241 (1941)]. L. S. G.

17.65 : 534.121.2 : 536.2.02 : 532.5.032 4

Finite Hankel transforms. SNEDDON, I. N. *Phil. lag.*, **37**, 17–25 (*Jan.*, 1946).—Some properties of the ansforms are given and their use in solving boundary alue problems for systems possessing axial symmetry discussed. This method is superior to the usual ne of eliminating the time by a Laplace transform, or it is quick and simple to use and avoids contour ntegration, which is often heavy when the latter ethod is used. Examples discussed are: (1) the ibrations of a circular membrane; (2) a problem in ne conduction of heat; and (3) the motion of a iscous fluid between coaxial infinite cylinders, the inner cylinder being kept at rest. For another example see Abstr. 1739 (1945). L. S. G.

517.65 : 621.392.1 5

Table of the integral $\frac{2}{\pi}\int_0^x \frac{\tanh^{-1} t}{t} dt$. CORRINGTON, M. S. *RCA Rev.*, **7**, 432–6 (*Sept.*, 1946).

517.836 : 536.2 = 397 *see Abstr.* 96

517.942.9 6

The numerical solution of Laplace's equation in composite rectangular areas. FROCHT, M. M. *J. Appl. Phys.*, **17**, 730–42 (*Sept.*, 1946).—An analytical method is developed which yields key values of a harmonic function U in rectangular figures, in terms of certain simple combinations of known boundary values, called Laplacian perimeters. All the remaining interior values can be directly and rapidly calculated from the key values. A.

517.947.44 : 538.551.25 : 534.01 *see Abstr.* 47

518.5 : 517.512.2 : 621.317.757 7

A photo-electric Fourier transformer. FÜRTH, R., AND PRINGLE, R. W. *Phil. Mag.*, **37**, 1–13 (*Jan.*, 1946).—[See Abstr. 365 (1946), 419 B (1945)].

518.5 : 621.318.572 8

The ENIAC, an electronic computing machine. HARTREE, D. R. *Nature, Lond.*, **158**, 500–6 (*Oct.* 12, 1946).—The machine operates by the counting of electrical impulses by electronic circuits, and though built primarily for the integration of differential equations by summation over a finite number of finite intervals, it is flexible enough for application to a wide range of computations. The basic units consist of sets of ten decade valve counters, one for each decimal place, which combine the functions of adding (or subtracting) unit, and "memory"; connections between the units are made by hand, by means of concentric cables and plugs, in the process of "setting-up" the machine. A pulse generator supplies a standard pattern of 10 μsec pulses every 200 μsec; this interval is called an "addition-time." Two sets of cables transmit, respectively, pulses representing numerical data, and "programme" pulses controlling the sequence of operations of the various units. Provision is also made for the recording or acceptance of data on punched cards. A set of intermediate results can thus be carried over to a later stage in the computation. The time taken for the multiplication of two 10-figure numbers is 3 msec, or 14 "addition-times"; a computation involving ten million multiplications therefore takes about 8½ hours, once the machine has been set up.

519.21 : 539.16.08 *see Abstr.* 148

519.283 : 620.113 9

Statistical methods in quality control. XI. Statistical tests of significant differences. *Elect Engng, N.Y.*, **65**, 466–8 (*Oct.*, 1946).—[For Part X see Abstr. 2014 (1946)].

ASTRONOMY . ASTROPHYSICS . GEODESY 52

521.032 10

Concentrations of the interstellar medium. WHIPPLE, F. L. *Astrophys. J.*, **104,** 1–10 (*July*, 1946).—The interstellar medium is envisaged as consisting chiefly of hydrogen gas in which dust particles are embedded. Concentrations are formed by the mutual attraction of the particles under the force of light-pressure, any slight concentration having a screening effect on surrounding particles in the general radiation field. These concentrations grow exponentially with time, but it is only in an already dense cloud that the rate of growth can be sufficiently rapid to account for the formation of a star. Eventually the concentration becomes large enough for accretion by gravity to dominate the process of growth. The condition that the concentration should be quiescent relative to the interstellar medium is necessary. G. C. McV.

522.2 : 535.317.25 = 5 11

The dependence of the resolving power of telescopes on stellar magnitudes. COLACEVICH, A. *Ric. Sci. Ricostruz.*, **16,** 70–4 (*Jan.–Feb.*, 1946) *In Italian.*—Astronomical observations suggest that the resolving power depends on the stellar magnitude, m, as well as on the wavelength of the light and the diameter, D, of the aperture. Analysis of double star observations by Dembowski and Schiaparelli show that the variation with m fits the formula $\frac{10{\cdot}5}{D}\{1+0{\cdot}11(m-5)\}$, for values of m between 5 and 9, D being in cm. V. C. A. F.

522.52 : 526.62 12

On the registration of the exact time of each exposure by cinematographic photography. MALMQUIST, K. G., NORINDER, H., AND STOFFREGEN, W. *Ark. Mat. Astr. Fys.*, **33 B** (*No.* 1) *Paper* 3, 7 *pp.* (1946).—Describes an apparatus to record exact times of exposures on cinematograph film using a double-ray oscillograph tube. The film registers the beats of a standard pendulum, the Rugby time signal, the time of each individual exposure and certain other control marks. The apparatus is to be used to record exposure times of the spectrum of the sun's edge at second and third contacts, so as to determine the difference in geodetic co-ordinates of points on the earth's surface, situated on an eclipse track. E. G. M.

523.11 13

Equations of state for radially symmetric distributions of matter. WYMAN, M. *Phys. Rev.*, **70,** 396–400 (*Sept.* 1 *and* 15, 1946).—It is well known that the line element corresponding to the homogeneous universe can be derived from the physical assumptions that the material with which we are dealing is radially symmetric and spatially isotropic. In order to obtain a more general cosmology the following physical assumptions are made: (1) The matter in the body is radially symmetric. (2) The matter comprises a perfect fluid at rest. (3) The matter obeys an equation of state of the form $p = p(\rho)$ where p is the pressure, ρ is the density. It is shown that the above assumptions lead to three possible cosmologies. One of these is, of course, the homogeneous universe and the other two are new. A.

523.11 : 538.3 14

A new approach to kinematic cosmology. (B). INFELD, L., AND SCHILD, A. E. *Phys. Rev.* **70,** 410–25 (*Sept.* 1 *and* 15, 1946).—[See Abstr. 981 (1946)]. Maxwell's equations, Lorentz's ponderomotive equations and Dirac's equations for the electron are investigated in space-times in which

$$ds^2 = \gamma(r,t)(dt^2 - dr^2 - r^2 d\theta^2 - r^2 \sin^2\theta d\phi^2)$$

where γ can have one or other of the forms (I) $\gamma = (1-a)^{-2} f\{t/(1-a)\}$; (II) $\gamma = \gamma(a)$; (III) $\gamma = \gamma(t)$ and $a = t^2 - r^2$. The theory differs from general relativity in that no use is made of Einstein's gravitational equations. Hence it can be shown that solutions of Maxwell's or Dirac's equations valid in flat space-time are also valid in open universes of type II or III. In closed universes of type I, each point has an image, and this imposes a boundary condition on the solutions. In such universes the possible frequencies of free radiation are restricted and, for the free electron, there is a connection between the atomic constants occurring in Dirac's equation and the "cosmological" function γ. G. C. McV.

523.11 15

Rotating universe? GAMOW, G. *Nature, Lond.*, **158,** 549 (*Oct.* 19, 1946).—The rotation of the stars can presumably be derived from the rotation of the galaxies, but no explanation of the rotation of the galaxies themselves is available. The suggestion is made that all matter in the universe is in a state of general rotation around some centre located beyond the reach of our telescopes, and the rotation of the galaxies derives from this. It is pointed out that the existence of such a centre can be confirmed and its direction determined by observations of the Oort effect in the radial velocities of the nearer galaxies.

523.112 : 531.51 16

Condensations in a non-static universe. NARLIKAR, V. V., AND KARMARKAR, K. R. *Nature, Lond.*, **158,** 550 (*Oct.* 19, 1946).—It is shown that Einstein and Straus's equations [Abstr. 374 (1946)] lead to the suggestion that no change in the external field beyond $r = r_0$ follows the condensation of the cosmic matter within the sphere $r = r_0$ into a spherical body of the same mass.

523.72 : 538.566 : 621.396.821 17

Conditions of escape of radio-frequency energy from the sun and stars. SAHA, M. N. *Nature, Lond.*, **158,** 549 (*Oct.* 19, 1946).—It is pointed out that ordinary waves of frequency <200 Mc/s cannot escape if they are generated further in than the corona, which is an "electron atmosphere" with a very low atomic concentration. Proton-electron recombination [Abstr. 2017 (1946)] is therefore ruled out as a mechanism of origin. However, conditions are much more favourable for the escape of extraordinary waves in the presence of sunspots, which have magnetic fields up to 4 000 gauss or even higher, and lower temperatures and therefore electron concentrations. The conclusion is drawn that any 10–200 Mc/s waves received on the earth originate from sunspots, and will be circularly polarized.

523.72 : 621.396.821 18

Solar radio noise. I. APPLETON, E. V., AND

[EY, J. S. *Phil. Mag.*, **37**, 73–84 (*Feb.*, 1946).—The esults of experiments on solar radio noise, especially ıose carried out during the period of sunspot activity, ın. 30 to Feb. 14, 1946, are interpreted. The ɔectrum of the noise was observed at sea-level. The ɔectral curve has a peak at a wavelength of about ın, but the shape on the long wavelength side is eformed by ionospheric influences. Large and ıdden increases in the intensity of the noise occur multaneously with solar flares and short-wave radio ıde-outs. L. S. G.

23.72 : 621.396.821 19

Abnormal solar radiation on 72 megacycles. LOVELL, .. C. B., AND BANWELL, C. J. *Nature, Lond.*, **158**, 17–18 (*Oct.* 12, 1946).—Surges of solar radiation, mounting at peak to $1{\cdot}3\times10^8$ times normal black-ody radiation, were observed at various times etween July 25 and Aug. 2, 1946. The main event, on July 25th, apparently coincided with the intense solar flare of that date.

523.841.1 : 523.87 = 5 20

Spectrographic observations of Nova T Cor B. GRATTON, L., AND KRÜGER, E. C. *Ric. Sci. Ricostruz.*, **16**, 299–301 (*March–April*, 1946) *In Italian.*—Spectra taken at Merate with a slit spectrograph and a prismatic camera in mid-Feb., 1946, show displaced emission and absorption components of the lines of H, He and ionized metals due to the nova itself, and an emission spectrum from the surrounding nebula comprising lines of H, He I, He II, of C, N and O in various ionization stages, and the forbidden oxygen lines typical of gaseous nebulae. The coronal lines appeared on Feb. 19th. The colour temperature deduced is 9 000°. The explosion is discussed in the light of the Zanstra recombination theory. A. HU.

523.87 : 523.841.1 *see Abstr.* 20

526.62 : 522.52 *see Abstr.* 12

PHYSICS 53

3.081.3 : 531.11 21

On the meaning of absolute systems in mechanics ıd physics. ZANSTRA, H. *Physica, 's Grav.*, **12**, 01–10 (*Aug.*, 1946).

3.081.5 22

On the dimensions of physical magnitudes (sixth aper). DINGLE, H. *Phil. Mag.*, **37**, 64–6 (*Jan.*, 946).—[See Abstr. 835 (1945)].

FUNDAMENTALS 530.1

30.12 : 512.94 *see Abstr.* 1

30.12 : 537.312.6 *see Abstr.* 117

30.14 23

On the energy loss of fast particles by ionization. ANDAU, L. *J. Phys., USSR*, **8** (*No.* 4) 201–5 (1944).—et $f(x, \Delta)$ be the probability that a particle of given nergy will lose an amount of energy lying between ı and $\Delta + d\Delta$, on traversing a layer x of material. ɛt $w(\varepsilon)$ be the probability of an energy loss ε. The ınction f satisfies the equation

$$\partial f/\partial x = \int_0^\infty w(\varepsilon)\{f(x, \Delta - \varepsilon) - f(x, \Delta)\}d\varepsilon$$

his is solved by a Laplace transformation, and f is xpressed explicitly in terms of a certain integral ınction whose properties (e.g. asymptotic expansion) e investigated. L. S. G.

30.14 24

On a modification of Klein's vector meson pair eory. BRULIN, O., AND HJALMARS, S. *Ark. Mat. str. Fys.*, **33 B** (*No.* 1) *Paper* 4, 5 *pp.* (1946).—ı a previous paper [Abstr. 682 (1946)] a special ıteraction between nucleons and mesons was used ı Klein's theory [Abstr. 2458 (1944)], but it was npossible to find a value of the interaction constant iving the same cutting-off distance in the S and P ates of the deuteron. An investigation is now made f all Lorentz-invariant pair interactions and a combination of these is taken which removes the higher singularities in the S state and preserves the general spin dependence. The static interaction potential is calculated for both states. A cutting-off distance is obtained which gives a quadrupole moment of the deuteron of $1{\cdot}2\times10^{-27}$ cm², which is about half the experimental value. L. S. G.

530.14 : 537.122 25

On the self-energy of the electron. RACAH, G. *Phys. Rev.*, **70**, 406–9 (*Sept.* 1 *and* 15, 1946).—Some evidence is given that the self-energy of an electron in the hole theory is finite, but coincides with mc^2 only if e^2/hc satisfies a particular equation. A.

530.145 : 538.3 26

On the connection of Dirac's quantum-electrodynamics and the theory of radiation damping. (Correction.) GORMLEY, P. G., AND HEITLER, W. *Proc. R. Irish Acad.*, **50 A** (*No.* 17) 271–2 (1945).—[See Abstr. 489 (1945)].

530.145 27

Relativistic quantum theory of complex particles. FRENKEL, J. *J. Phys., USSR*, **9**, 465 (1945).—It is shown that the classical relativistic theory is unable to describe the motion of complex particles and that it is impossible within the frame of this theory to separate the motion into that of the centre of gravity and the relative motion, the former becoming ambiguous. These difficulties are removed if the classical theory is replaced by the quantum one. Starting from a non-relativistic quantum description of the motion of a complex particle, it is possible to give a generalized relativistic form of the wave equation, describing the motion of the particle as if it were a material point, i.e. an elementary particle endowed with certain inner properties. This treatment is in agreement with the fact that light particles lose their individuality when they are bound together, or with heavier particles, if their binding energy is larger than their own rest energy. A.

530.145 : 537.133 28

On the theory of scattering of protons by protons. LANDAU, L., AND SMORODINSKY, J. *J. Phys., USSR*,

8 (*No.* 3) 154–62 (1944).—The wave equation for a proton in a Coulomb field is solved in terms of Whittaker functions, in the case $l = 0$ (*S*-scattering), and a formula is deduced for the phase constant. This is used in conjunction with experimental data to discuss the existence of a stable level in the system consisting of two protons. It is found that there is no stable level. No assumption is made as to the shape of the potential energy curve between the protons and it is shown that the approximate equality of the *p–p* force and the *p–n* force can be deduced without the aid of a rectangular well. Scattering of protons by deuterons, and neutrons and protons by α-particles, are briefly discussed. L. S. G.

530.145.63 : 538.3 29

On the Heisenberg picture in quantum electrodynamics. MA, S. T. *Chin. J. Phys.*, **6**, 36–49 (*July*, 1945).—The form of the quantum theory of radiation which was introduced by Heisenberg in 1931 [Abstr. 2969 (1931)] is compared with the transformation theory of Dirac [Abstr. 2042, 2496 (1927)]. The theory of the interaction of an electron with a radiation field is studied in detail and Heisenberg's method is shown to be equivalent to Dirac's method of variation of parameters. The extension of Heisenberg's method to eigenvalue problems is discussed. This extension was first made by Weisskopf for the self-energy of the electron [Abstr. 4541 (1934), 3149 (1939)] and a general proof is given of the equivalence of Weisskopf's method and the method of the perturbation theory of stationary states. L. S. G.

GENERAL MECHANICS . MECHANICS OF SOLIDS 531

531.11 : 53.081.3 *see Abstr.* 21

531.19 : 541.183.1 *see Abstr.* 171

531.258 = 397 30

Unsymmetrically loaded disc with radially decreasing bending strength. LINDHOLM, T. *Tekn. Tidskr.*, **76**, 925–6 (*Sept.* 21, 1946) *In Swedish.*—Assuming a bending strength of the form $N = kr^2 + N_0$ where k and N_0 are constants, and writing the differential equation in polar co-ordinates, the deformation, shear stress and bending stresses are determined for a disc rigidly fixed along the outer circular edge. J. A. W.

531.51 : 523.112 *see Abstr.* 16

531.51 : 535.41 = 4 *see Abstr.* 93

531.571 : 533.75 *see Abstr.* 45

MECHANICAL MEASUREMENTS 531.7

[531.715.082.72 + 531.78.082.72] : 621.317.39 = 5 31

Electrostatic methods for the measurement of displacement, force and pressure. GIGLI, A. *Alta Frequenza*, **10**, 516–58 (*Aug.–Sept.*, 1941) *In Italian.*—[Abstr. 85 B (1947)].

[531.78.082.72 + 531.715.082.72] : 621.317.39 = 5 *see Abstr.* 31

531.788.7 32

An easily constructed all-metal vacuum gauge. WEBBER, R. T., AND LANE, C. T. *Rev. Sci. Instrum.*, **17**, 308 (*Aug.*, 1946).

MECHANICS OF LIQUIDS 532

532.13 : 541.132 33

Viscometric studies of chemical equilibria. DRUCKER, C. *Ark. Kemi. Min. Geol.*, **22 A** (*No.* 6) *Paper* 21, 17 *pp.* (1946).—Simple relationships between the viscosity of a fluid and its purely static properties are now investigated, for which purpose the internal frictions of non-electrolytes and of strong and weak electrolytes have been measured at 25°. The strong electrolytes afforded data quantitatively in accord with the Jones–Falkenhagen formula [Abstr. 1773 (1933)]. A formula corresponding to this, but considering the dissociation of incompletely dissociated electrolytes, has been confirmed. The frictional effect of semi-electrolytes in completely dissociated and in entirely undissociated condition has been calculated from the data found; from that effect it has been found possible to derive the degree of dissociation in final concentration. The dimery constant derived from the internal friction was found to be in agreement with the value derived from the volume effects. The course of the concentration/intrinsic viscosity relation is closely related to that of the partial specific volume. H. H. HO.

532.133 : 541.132 = 4 *see Abstr.* 169

532.5 = 4 34

Conservation of proper-mass. The notion of a perfect fluid. DE BEAUREGARD, O. C. *C.R. Acad. Sci., Paris*, **222**, 271–3 (*Jan.* 28, 1946) *In French.*—The paper contains a brief summary of certain mathematical theorems on the motion of a fluid in its 4-dimensional aspect. An incompressible fluid is defined. When the force 4-vector is the gradient of a scalar, the motion of the fluid may be such that along lines and tubes of flow the velocity 4-vector is irrotational. G. C. McV.

532.5.032 : 534.121.2 : 536.2.02 : 517.65 *see Abstr.* 4

532.5.032 : 539.501 = 82 35

A characteristic of the mechanical properties of liquids obtained by blowing-off radially a liquid layer in a narrow plane-parallel slit. KUSAKOV, M., AND KRUIM, K. *J. Exp. Theor. Phys.*, **16** (*No.* 3) 266–78 (1946) *In Russian.*—The method gives information on the rheological properties of liquids such as lubricating oils. A.

532.525 = 4 36

The maximum increase of the momentum realisable by means of an injector. CHALOM, J. *C.R. Acad. Sci., Paris*, **222**, 1028–30 (*April* 29, 1946) *In French.*—In continuation of previous work [Abstr. 2950 (1937)], the author discusses the magnitude of the momentum theoretically realizable by means of a jet of gas issuing from a convergent nozzle with supersonic velocity into a cylindrical mixing tube into which a flow of incompressible fluid is induced. M_0V_0 and M_2V_2 being respectively the momentum of the jet

id of the mixed fluids, it is shown that the max. alue of the ratio M_2V_2/M_0V_0 is approximately 2. J. S. G. T.

2.542 = 4 37

The variable phase of shut-off of the flow of viscous quid in a horizontal tube connected to a reservoir. AMBOSSY, P. *Helv. Phys. Acta*, **19** (*No.* 4) 266–84 946) *In French.*—The following problem is dis- ssed: A horizontal tube is connected with a reservoir which a constant head of liquid is maintained. The d of the tube is progressively closed. Determine ow the velocity (u), and pressure (H), in the tube ry with time. Theoretical values of u and H are good agreement with experimental results obtained Müller [*Helv. Physiol. Acta*, **4** (*No.* 2) (1946)] relat- g to the flow of glycerine-water mixtures, except for al values of H on closure of the tube: experi- ental final values are notably less than the cal- lated values. Müller suggests that this deficit is tributable to elasticity of the wall of the tube and mpressibility of the liquid. This point is being vestigated. Throughout, viscosity plays a decisive le. J. S. G. T.

CAPILLARITY 532.6

32.61.08 38

A centrifugal method of measuring the surface nsions and interfacial tensions of liquids. MEYER- EIN, W., AND MORGAN, J. D. *Phil. Mag.*, **37**, 41–7 'an., 1946).—A continuation of previous work Abstr. 2126 (1944)]. A bubble method and a eniscus method are described and the necessary eory and formulae are presented. Previously the itial form of the meniscus had to be hemispherical; t this is not always satisfied, and the new methods vercome this limitation. The meniscus method is nvenient for measuring interfacial and surface nsions of viscous liquids and mobile liquids whose gle of contact is not zero. The bubble method is tter in other cases. Both are especially useful when ly small quantities of liquid are available. L. S. G.

32.612.3 : 539.23 = 4 *see Abstr.* 161

KINETIC THEORY OF LIQUIDS 532.7

32.7 : [536.413 + 536.613 + 536.75] : 548.0 *see Abstr.* 175

32.72 : 535.42 39

Diffusion coefficients determined by means of the resnel diffraction. OBREIMOV, I. V. *J. Phys., SSR*, **8** (*No.* 3) 142–7 (1944).—Diffusion in one mension, governed by $\partial c/\partial t = D\partial^2 c/\partial x^2$, is con- dered. Here c is the concentration, D is the ffusion coefficient. The solution is expressed a Fourier series in x, with coefficients which e functions of t. A formula for D, in terms of ese coefficients, is given, and this may be used to lculate D if the distribution of the concentration is termined at two times t_1 and t_2. An experimental ethod for doing this is described, the optical arrange- ents being discussed in detail. The accuracy of the periments is investigated and it is suggested that the ethod will be useful in the determination of the velocity of sedimentation of substances with a high molecular weight in the ultra-centrifuge. L. S. G.

532.74 : 536.44 40

Liquid association and the critical temperature. BRESCIA, F. *J. Chem. Phys.*, **14**, 501–2 (*Aug.*, 1946).—The general form of the pressure-volume curve has been calculated on a statistical mechanical basis [Abstr. 979 (1938)] and the diagram obtained for a pure liquid/saturated vapour system is such that two characteristic temperatures T_m and T_c may exist. At T_m surface tension vanishes, but the true critical temperature T_c is higher, being the temperature of the isotherm which has zero $\left(\frac{\partial P}{\partial V}\right)_T$ at one volume only. The present paper examines the published data for 12 substances and finds that CO_2 and the saturated lower hydrocarbons, typical unassociated liquids, show no significant differences between T_c and T_m, while the more strongly associated lower ethers, alcohols and water appear to have measurable intervals. This is to be expected since definite ordered structure is more likely to persist above T_m if the liquid is associated. L. G. C.

MECHANICS OF GASES 533

533.5 41

A vacuum "lead-in." HERNE, H. *J. Sci. Instrum.*, **23**, 244 (*Oct.*, 1946).—A metal-rubber anti-vibration bush was adapted to form a simple insulated conductor for currents up to 50 A.

533.6.07 : 621.317.39 = 5 42

A turbulence analyser. DILDA, G. *Alta Frequenza*, **9**, 594–620 (*Oct.*, 1940) *In Italian.*—A description of an apparatus for the analysis of turbulence in wind tunnels. It consists of a Pt wire anemometer, 0·01 mm dia. and a few millimetres long, mounted on a suitable support permitting adjustment of the wire along the cross-section of the wind tunnel under test. The wire is heated to a high temperature by d.c. The resistance variations produced by the cooling effect of the turbulence develop a variable voltage which is amplified by a 4-stage amplifier of gain $\times 10^6$, which also compensates for the thermal inertia of the wire. A description is also given of the measuring instrument (a thermo-couple milliammeter suitably protected) and of the bridge circuit for calibrating the whole apparatus. Curves and experimental results are reported, which show the behaviour of the apparatus and its possible applications. A.

533.6.07 : 621.34 43

Electric equipment for Cornell variable density wind tunnel. CLYMER, C. C., AND DE FERRANTI, M. A. *Trans. Amer. Inst. Elect. Engrs*, **65**, 554–62 (*Aug.–Sept.*, 1946).—[Abstr. 113 B (1947)].

KINETIC THEORY OF GASES 533.7

533.7 44

Motion of a particle in a temperature gradient; thermal repulsion as a radiometer phenomenon. ROSENBLATT, P., AND LAMER, V. K. *Phys. Rev.*, **70**, 385–95 (*Sept.* 1 *and* 15, 1946).—The dependence on temperature gradient, pressure and particle radius, a,

of the velocity of thermal repulsion of tricresyl phosphate droplets suspended in air was measured and compared with the velocities calculated from radiometer theory. Thermal repulsion is shown to be a radiometer effect. The velocity of thermal repulsion $\propto$ the temperature gradient, and at constant pressure increases with decreasing a to a maximum when the mean free path, l, $\simeq 1{\cdot}5\ a$, and then decreases. It is approximately $\propto 1/P$ when $L/a < 0{\cdot}5$. The dependence of the force of thermal repulsion on temperature gradient, pressure, and a are in agreement with the requirements of radiometer theory at high pressures. The resistance of air to the motion of the droplets is accurately given by Millikan's equation; the coefficient of slip is $8{\cdot}25\times10^{-6}$ cm at 76 cm pressure and 30°c. The measured velocities of thermal repulsion agree satisfactorily with the theoretical values calculated from the resistance of the medium and the radiometer forces as given by Einstein [Abstr. 2724 (1924)] and by Epstein [Abstr. 2425 (1924)]. The numerical agreement is satisfactory in view of the approximations in the theoretical derivations and the uncertainty in the heat conductivity of the tricresyl phosphate. Thermal repulsion can be used to determine the radius of particles too small to be measured by sedimentation velocity. A.

533.75 : 531.571 45

The thermodynamic properties of the products of high-pressure combustion. CORNER, J. *Proc. Phys. Soc., Lond.*, **58**, 737–58 (*Nov.*, 1946).—The internal energy, heat content, specific heats and equilibrium constants of the normal products of combustion are expanded as power series in the density. At pressures up to 40 tons/in², corresponding to densities of about 0·35 gm/cm³, only the first three terms need be kept. Thus the pressure-dependence of the thermodynamic properties can be evaluated from a knowledge of the second and third virial coefficients of the various product gases. Tables are presented based on the most recent intermolecular forces, and covering the range from 1 600°K to 4 000°K. These tables have found considerable application to internal ballistics, and give "covolumes" of propellants with a systematic error of less than 5%. A.

533.75 : 536.71 46

Some properties of a van der Waals gas. WANG, J. S. *Chin. J. Phys.*, **6**, 27–35 (*July*, 1945).—The thermodynamic functions for an ideal substance obeying van der Waal's equation are obtained by using the condition that these functions reduce to those of a perfect gas in the case of vanishing pressure. The volumes of the liquid state and the gas state are determined by Maxwell's rule of equal areas and are expressed in parametric form. The Joule–Thomson effect is discussed and curves of the inversion temperature are given. A mixture of van der Waal's gases is taken and the dependence on the composition of parameters appearing in the formulae for the volumes of the liquid and gas states is considered briefly. L. S. G.

VIBRATIONS : ACOUSTICS 534

534.01 : 517.947.44 : 538.551.25 47

On the numerical treatment of forced oscillations. SUGAR, A. C. *Quart. Appl. Math.*, **4**, 193–6 (*July*, 1946).—A harmonic oscillator subject to the action of a disturbing force, $ma(t)$, is governed by $\ddot{x} + \omega^2 x = a(t)$, and a solution is given by $x = \omega^{-1} D$ where $D = \int_0^t a(\tau) \sin \omega(t-\tau) d\tau$. A simple approximate expression is found for D, and this is convenient for evaluating x and related quantities such as the maximum acceleration ($\ddot{x}$) and displacement. The expression for D is obtained by replacing the curve of $a(t)$ against t by a series of lines and hence the integral for D by a sum of integrals which may be evaluated at once. The final form is

$$\omega D = A - \omega^{-1} \sum_i (\lambda_{i+1} - \lambda_i) \sin \omega(t - t_i)$$

L. S. G.

534.121.2 : 536.2.02 : 532.5.032 : 517.65 *see Abstr.* 4

534.21 48

The propagation of sound in the atmosphere—attenuation and fluctuations. KNUDSEN, V. O. *J. Acoust. Soc. Amer.*, **18**, 90–6 (*July*, 1946).—Following a summary of earlier work, experiments in progress to determine the absorption of audible sound in air containing different amounts of water vapour are outlined, and the importance of such data in connection with room acoustics, public address and sound-ranging systems is emphasized. Reference is also made to measurements, at frequencies between 500 and 4 000 c/s, of the attenuation of sound in air containing lycopodium spores, but it is shown that the agreement with values calculated from Epstein's equation is not very satisfactory. A laboratory investigation of previously observed fluctuations in the intensity of sound propagated through the atmosphere is described, the effect being attributed to temperature turbulence of the air. For frequencies between 8 and 16 kc/s, the magnitude of the intensity fluctuations is proportional to the square of the sound frequency. G. F. H.

534.213 49

The propagation of waves in orthotropic media. CARRIER, G. F. *Quart. Appl. Math.*, **4**, 160–5 (*July*, 1946).—An extension of a previous paper [Abstr. 1987 (1945)]. The displacements are written in terms of the potential, ϕ, and the differential equations governing the stress and expressing equilibrium are obtained. These are transformed into wave equations, the solutions of which are discussed. The final result is an expression for ϕ in the familiar form of a retarded potential. L. S. G.

534.222.2 50

Non-linear propagation of underwater shock waves. OSBORNE, M. F. M., AND TAYLOR, A. H. *Phys. Rev.*, **70**, 322–8 (*Sept.* 1 *and* 15, 1946).—Comparative measurements at large and small distances have been made on the pressure wave from a small underwater explosion. It is shown that: (1) there is a small departure from the $1/r$ law for the peak pressure; (2) there is no detectable change in shape or "spreading" of the pressure wave with propagation; and (3) the shock front is discontinuous within the limitations of the apparatus. A theory is developed which is in quantitative agreement with (1) and (3), but predicts a small spreading of the profile of the

ave large enough to have been detected. The theory ows that a spherically diverging wave of any nplitude always becomes discontinuous eventually. practice the distance over which it must propagate fore becoming discontinuous may be enormous. A.

34.222.2 : 623.54 = 3 51

Acoustics of detonations and gunblast. FURRER, W. chweiz. Arch. angew. Wiss. Tech., **12**, 213–19 (*July*, 946) *In German.*—The characteristics of such plosions are discussed and it is shown that the npulse can be calculated from the weight of explosive used. Experimental curves are shown dicating the variation in maximum pressure with stance and with weight of charge. The variation of locity of the wave with distance from the muzzle shown graphically. Very close to the muzzle the locity is as high as 2 000 m/s, falling rapidly to 0 m/s at a distance of 1 m. Reference is made to e energy in the explosion wave and to the frequency ectrum of explosions. The oscillographic recording pparatus is described. A. B. W.

34.231.2 : 534.321.9 : 620.179.16 52

Standing wave technique of thickness measurements. UTLER, J. B., AND VERNON, J. B. *J. Acoust. Soc. mer.*, **18**, 212–15 (*July*, 1946).—Measurements of e thickness of steel plates using the Firestone rpersonic reflectoscope showed that, in certain ses, there were discrepancies between the computed d observed first mode standing wave frequency *v.* ickness curves. Moreover, the natural frequency of e crystal affected the calibration curve, although ystals of the same frequency gave identical calibraons despite differences in damping of the crystal ount. Certain anomalies in the resonant frequency thickness curves are described in confirmation of restone's results. Attempts to measure unknown icknesses of a given steel by finding the first mode ere only partially successful and a method is scribed, involving the determination of the resonant equencies of different modes with reference to a libration curve of the same material, which gave an curate estimate of the thickness without the need r knowing which particular mode was being easured. In general, thickness measurements were curate to within 2%, but this could be considerably proved by careful adjustment of the controls. he best results were obtained with *X*-cut crystals perated at resonance or over a band of $(1 \pm \frac{1}{4})$ sonant frequency. H. J. H. S.

34.231.3 : 621.395.612.4 53

Motional impedance analysis applied to a dynamic icrophone. WHITE, J. E. *J. Acoust. Soc. Amer.*, **18**, 5–60 (*July*, 1946).—Fay has given [Abstr. 2521 B 943)] a method for calculating the complete perrmance at any frequency of an electro-magnetic eaker from a plot of its electrical impedance easured when the speaker is loaded by a closed air olumn of variable length. The present article applies is method to a dynamic microphone, yielding ressure sensitivity at lower audio-frequencies and rovides a means of calculating microphone echanical impedance and other characteristics. nprovement in accuracy which may be achieved by roper choice of area for closed air column is discussed. A.

534.231.3 = 5 54

On the possibility of using "thin laminae" as impedance adapters for the transmission of elastic vibrations between two different media. NUOVO, M. *Ric. Sci. Ricostruz.*, **16**, 88–91 (*Jan.–Feb.*, 1946) *In Italian.*—Discusses the possibility of generating ultrasonic vibrations of considerable intensity in gases by means of piezo-electric vibrations of a crystal placed in a liquid, the ultrasonic waves passing into the gas by a suitable system of "impedance adapters" whose purpose is to eliminate reflection losses at the liquid-gas interface. V. C. A. F.

534.232 : 621.395.623.7 55

Effects of finite baffles on response of source with back enclosed. NICHOLS, R. H., JR. *J. Acoust. Soc. Amer.*, **18**, 151–4 (*July*, 1946).—The effect of a finite circular baffle on the axial response-frequency characteristic of a central sound source in which sound from the back side of the diaphragm is completely suppressed was found to consist of an orderly series of peaks and valleys whose characteristics depend upon the diameter of the baffle and the measuring distance. Experimentally determined values of the frequencies agree with values computed on the hypothesis that the phenomenon is one of interference between sound direct from the source and sound which travels radially along the baffle and is "reflected" from its edge to the microphone. This assumption also accounts qualitatively for the increase of magnitude of the peaks and valleys with increasing distance from the baffle. Baffles not symmetrical with respect to the sound source produce an irregular effect. A.

534.321.9 : 541.133 56

The effect of ultrasonic waves on the conductivity of salt solutions. FOX, F. E., HERZFELD, K. F., AND ROCK, G. D. *Phys. Rev.*, **70**, 329–39 (*Sept.* 1 *and* 15, 1946).—An adiabatic compression raises the conductivity of an aqueous salt solution because of direct pressure influence and of temperature increase. An ultrasonic wave therefore modifies periodically the conductivity of the solution. If a filament of current passes normal to the wave propagation direction, the wave train produces under proper conditions an alternating potential (about 220 μV/atmos. volt in $CuSO_4$). At wavelengths shorter than the cross dimension of the current, the effect decreases. This permits the construction of a convenient receiver indicating absolute intensity for the investigation of ultrasonic fields in water, provided the frequency is not above 1·5 Mc/s. A.

534.321.9 : 620.179.16 : 534.231.2 *see Abstr.* 52

534.62 = 5 57

The absorption of sound by systems of resonators. GIGLI, A. *Alta Frequenza*, **9**, 717–44 (*Dec.*, 1940). *In Italian.*—Considers the absorption of sound by systems of resonators formed by placing perforated rigid sheets at a convenient distance from the walls. The frequency characteristics of the absorption coefficient deduced from theory are compared with the results of experiments made with stationary waves in a pipe. V. C. A. F.

534.843 58

Note on normal frequency statistics for rectangular rooms. BOLT, R. H. *J. Acoust. Soc. Amer.*, **18**,

130–3 (*July*, 1946).—Earlier mathematical results are displayed by three charts. The first may be used to determine the average number of normal frequencies, up to a given frequency, in a rectangular room of given volume and dimension ratio. The low frequency spacing index, which is a measure of the sound transmission irregularity or response roughness of the room over a specified frequency range, is shown in the second chart as a function of rectangular room proportions. The third chart shows room proportion criteria for obtaining the dimension ratios which give the smoothest frequency response at low frequencies in small rectangular rooms. G. F. H.

534.844.1 = 5 59

A method for the continuous measurement of the time of reverberation. CAMBI, E. *Ric. Sci. Ricostruz.*, **16**, 85–7 (*Jan.–Feb.*, 1946) *In Italian.*—The suggestion is made that the time of reverberation may be more accurately measured by employing a source of sound varying harmonically with the time. No experimental tests have been made of the method, which is based on the "equalization" tendency of reverberations to variations of amplitudes. V. C. A. F.

534.844.3 60

The modulation of sound decay curves. WATSON, R. B. *J. Acoust. Soc. Amer.*, **18**, 119–29 (*July*, 1946).—The causes of deviations of the sound decay curve for a room from a simple exponential are discussed theoretically. Experiments on the modulation of sound decay curves in a small marble chamber and ten acoustically different rooms are described, compensation being made for the average slope of the decay curve by using an amplifier whose gain is automatically increased exponentially with time. Measurements were made over a range of frequencies with the microphone and loud speaker at various positions in the rooms. The average reverberation time and average maximum modulation amplitude, plotted against the frequency of the sound, are shown for each of the rooms. The average maximum amplitude of the modulation frequencies as a function of the modulation frequency, is similarly displayed. It is pointed out that the interpretation of these curves in terms of the acoustical quality of the rooms cannot be made unless subjective tests are also undertaken. G. F. H.

OPTICS . RADIATION . SPECTRA 535

535.23.08 : 537.312.62 61

A fast superconducting bolometer. ANDREWS, D. H., MILTON, R. M., AND DE SORBO, W. *J. Opt. Soc. Amer.*, **36**, 518–24 (*Sept.*, 1946).—The bolometer, used for the fast detection of infra-red signals, consists of a 0·25 mil ribbon of CbN attached to a Cu base plate by an insulating film of Bakelite cement, and placed beneath a rock salt window in the vacuum chamber of a cryostat. For best operation the temperature must be maintained within a certain region of the superconducting transition zone at about 15°K where $dR/dt = 10\,\Omega$/degree and $R = 0{\cdot}2\,\Omega$. It has a compound response: primary response time, 5×10^{-4} sec; secondary, 5×10^{-2}. The response is 6 db below the maximum at 3 000 and 140 c/s for the primary and secondary responses respectively. The noise level varies with temperature and passes through several minima in the transition zone, being even there at least 10× the value in either the normal or superconducting state. In the primary range a signal of 5×10^{-4} μW is equivalent to the noise. A.

535.23.08 : 621.317.39 : 536.52 *see Abstr.* 105

535.234 : 536.7 62

A non-quantum indication of Planck's radiation formula. DINGLE, H. *Phil. Mag.*, **37**, 47–58 (*Jan.*, 1946).—The line of thought in a previous paper [Abstr. 208 (1945)] is developed further and a new condition is imposed on the function representing the distribution of energy in the spectrum of a black-body. This is the condition of invariance to a change of the co-ordinate system. It is shown that Planck's formula, but not the Rayleigh–Jeans formula, satisfies the condition. Other formulae, however, also satisfy the condition and the uniqueness of the solution remains an open question. The possibility of a new thermodynamics is discussed with reference to the present results. L. S. G.

535.241.33 : 536.521.089.6 : 621.326.4 63

Factors affecting the reproducibility of brightness of tungsten strip lamps for pyrometer standardization. BARBER, C. R. *J. Sci. Instrum.*, **23**, 238–42 (*Oct.*, 1946).—A quantitative examination is made of the effect of the experimental conditions on the apparent brightness of the lamps. It is shown that unless certain precautions are observed appreciable differences in brightness may occur as a result of gradients of temperature in the lamp filament and of ambient temperature changes. Owing to the Thomson effect it is important to ensure that a consistent lamp polarity is maintained. The effect of reflexions from the glass envelope of the lamp is considered and the most satisfactory sighting conditions determined to minimize this effect. Convective cooling of the filament in a gas-filled lamp necessitates precise positioning of the lamp relative to the vertical. A.

535.312.2 64

Reflection in a corner formed by three plane mirrors. SYNGE, J. L. *Quart. Appl. Math.*, **4**, 166–76 (*July*, 1946).—A systematic study is made of the optical behaviour of all corners. If the angles of the corners are not right angles there are in general 6 reflected beams. Reflection in a plane mirror is equivalent to a rotation, about the mirror-normal, through an angle π. This is the basis of the method used. The transformation due to reflection in a corner is equivalent to a rotation, θ, about an axis, A, called the optic axis. When the 6 different orders of reflection are considered it is found that θ is constant and that there are 3 optic axes A_1, A_2 and A_3. Formulae are found for θ and for the construction of A_1, A_2 and A_3. A vector method is used. L. S. G.

535.317 65

A transformation of known astigmatism formulae. HOPKINS, H. H. *Proc. Phys. Soc., Lond.*, **58**, 663–8 (*Nov.*, 1946).—The use of effective "centres" and "radii" of curvature permits the well-known formulae relating the tangential and sagittal centres of curvature of a wave-front element before and after refraction to

e put into a form which yields formulae and com-uting schemes identical with those customarily used or computing the paraxial focus, magnification, and quivalent focal length. Simple expressions follow or the *T*- and *S*-magnifications and oblique equivalent ocal lengths. A.

35.317.1 = 82 66

The perfect optical image from the viewpoint of the ave theory. MANDELSHTAM, L. *J. Exp. Theor. hys.*, **16** (*No.* 4) 302–5 (1946) *In Russian.*

35.317.25 : 522.2 = 5 *see Abstr.* 11

35.317.4 : 535.8 = 82 67

Effect of spherical aberration on the photometric haracteristics of optical apparatus. SHESMINTSEV, A. A. *J. Tech. Phys., USSR*, **16** (*No.* 2) 255–6 (1946) *Russian.*

35.319 68

On the Zernike phase-contrast test. LINFOOT, E. H. *roc. Phys. Soc., Lond.*, **58**, 759–68 (*Nov.*, 1946).—diffraction theory of the Zernike test is developed or the case where the dimensions of the light source re negligibly small, and applied to estimate the ensitiveness of the test for detecting local zones in n otherwise true mirror. The effects of varying the ze of the phase-retarding disc on the appearance nder test of a true mirror are considered, and the onclusion is drawn that it is these effects, rather than onsiderations of sensitivity, which mainly determine ie upper limit to the useful size of the disc. A.

35.321 : 535.341 : 535.39 *see Abstr.* 91

35.321 : 535.42 = 82 69

A method for measuring refractive index over a ide temperature range. OBREIMOV, I. *J. Exp. heor. Phys.*, **16** (*No.* 3) 253–8 (1946) *In Russian.*—he method is applied to plane-parallel glass plates nd is based upon the observation of Fresnel diffrac-on fringes at the edges. Variation of the path ifference due to thermal expansion is eliminated by simultaneous observation of the Haidinger rings. leasurements on a fused silica plate over the range 0–776°C are recorded. A.

35.33.03 : 535.338.35 : 545.822 : 536.55 70

On the influence of foreign elements on the intensity f spectrum lines in the flame of acetylene. HULDT, . *Ark. Mat. Astr. Fys.*, 33 A (*No.* 1) *Paper* 5, 22 *pp.* 946).—The Lundegårdh method of chemical nalysis from flame spectra is reviewed. The in-uence of one element on the strength of the spectrum ne of another is discussed; it is usually small <10%), but in a few cases may be important, e.g. eakening of Ca resonance line by Al, strengthening Sr line by Ca. The principles of light emission om flames are discussed. To test whether the fluence of one element on another is due to changes the concentrations of free atoms, ions, etc., or to anges in the excitation temperature, measurements temperature are made by the spectrum-line version method. The theory of this is discussed. is found that this temperature is the same, 670 ± 40°K, for Ca, Sr and Li in a flame, and at Al does not affect the inversion temperature of a, or Ca that of Sr. Hence the influence of one ement on the emission of another is not due to ange in the excitation temperature but to changes in chemical concentration; complexes, such as CaAl, may be formed. The temperature distribution across the flame is examined. A. G. G.

535.33.071 71

Small prism infra-red spectroscopy. BARNES, R. B., MCDONALD, R. S., WILLIAMS, VAN Z., AND KINNAIRD, R. F. *J. Appl. Phys.*, **17**, 532 (*June*, 1946).—Erratum. [See *Abstr.* 2234 (1945)].

535.33.071 : 621.396.611.4 72

Theory of a microwave spectroscope. LAMB, W. E., JR. *Phys. Rev.*, **70**, 308–17 (*Sept.* 1 *and* 15, 1946).—The measurement of Abstr. 80 (1947) is based on the assumption that the thermocouple readings are proportional to the Q of the cavity and its contents. The conditions for this are investigated theoretically. An expression for the Q of a hole in the wall of the cavity is derived for use in absolute measurements. A.

535.33.072 = 4 73

The correction of the effect of slit width of a spectrograph on the intensity curves of spectral lines. BOILLET, P. *Rev. Opt.* (*Théor. Instrum.*) **24**, 85–92 (*April–June*, 1945) *In French.*—A graphical method of obtaining the true intensity curve from that observed. The methods of Raleigh and of Burger and van Cittert are discussed critically, the present one lacking their shortcomings. The case when the line is narrower than the slit-image is discussed, and an example is given. H. H. HOP.

535.331 74

Preliminary description and analysis of the first spectrum of uranium. KIESS, C. C., HUMPHREYS, C. J., AND LAUN, D. D. *J. Res. Nat. Bur. Stand., Wash.*, **37**, 57–72 (*July*, 1946).—Observations of the arc and spark spectra of U afforded a separation of the lines of neutral atoms from those of ions. A list of more than 9 000 lines with accurate wavelengths, wave numbers, and estimated intensities, for the region 2 900 Å to 11 000 Å, has been compiled. About 2 000 of these lines have been classified as combinations between 18 low and metastable odd energy levels with about 280 high even levels. Well-resolved Zeeman patterns give g-values for several low levels that identify them as components of ^5L, ^5K, ^7M, and ^7K terms arising in the electron configurations f^3ds^2 and f^3d^2s. The spectrum of U is interpreted as that of a rare-earth element analogous to Nd, U being the third member of a second group of rare earths beginning with Th. From the fact that U is easily ionized in electric arcs and magnetic fields, and also that the short-wave limit of the observed spectrum does not extend below 2 900 Å, it is concluded that the ionization potential of neutral U atoms is approximately 4 volts. A.

535.336.2 : 537.533.72 = 3 *see Abstr.* 126

535.338.35 : 545.822 : 536.55 : 535.33.03 *see Abstr.* 70

535.338.4 75

The band-spectrum of copper oxide. GUNTSCH, A. *Ark. Mat. Astr. Fys.*, 33 A (*No.* 1) *Paper* 2, 8 *pp.* (1946).—A rotational and vibrational analysis has been made for five bands of the red system of CuO. The bands show single P and R branches, with indications of an $^RQ_{21}$ branch. The transition is

probably $^2\Sigma - {}^2\Sigma$. The following formula is given for the vibrational structure,

$$\nu_0 = 16\,273{\cdot}9 + 285{\cdot}6(v'+\tfrac{1}{2}) - 9{\cdot}2(v'+\tfrac{1}{2})^2 - [318{\cdot}6(v''+\tfrac{1}{2}) - 4{\cdot}4(v''+\tfrac{1}{2})^2]$$

The rotational constants are $B''_e = 0{\cdot}632$, $B'_e = 0{\cdot}591$. A. G. G.

535.338.4 : 536.55 76

Rotational perturbations in the band-spectrum of beryllium oxide. LAGERQVIST, A. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 1) *Paper* 8, 14 *pp.* (1946).—Perturbations in the excited $^1\Pi$ and $^1\Sigma$ states of BeO are examined experimentally and their theoretical interpretation is discussed. They are of Dieke's type *A* (for which $\Delta\Lambda = 1$); the matrix elements of the perturbing states are determined by Kronig's method. In some cases extra lines occur; these are due to doubling of the perturbed levels. The intensity distribution is examined and found to agree with that expected from theoretical expressions of Ittmann and Dieke. The temperature of the BeO arc was determined as 4 700 ± 500°K. A. G. G.

535.34 = 4 77

The absorption coefficient of ozone in the region of the Huggins bands. BARBIER, D., AND CHALONGE, D. *Ann. Phys., Paris*, **17**, 272–302 (*June–July–Aug.*, 1942) *In French.*—Values for the absorption coefficients of O_3 between 3 439 and 3 130 Å have been made with improved precision. Measurements have been made for the principal absorption maxima and minima at temperature of −95°, −50°, −30°, +18°, +65°, and +95°c. The curves of absorption coefficient against temperature are of roughly parabolic form. The coefficient is independent of pressure. A. G. G.

535.341 : 535.321 : 535.39 *see Abstr.* 91

535.343.3–15 78

Infra-red absorption cell for liquids. COGGESHALL, N. D. *Rev. Sci. Instrum.*, **17**, 343–4 (*Sept.*, 1946).

535.343.4 79

Absorption bands of alkali atoms in the presence of foreign gases. WU, T.-Y. *Chin. J. Phys.*, **6**, 17–20 (*July*, 1945).—It was recently suggested [Abstr. 2149 (1944)] that the bands are due to the increase in the energy of the optical electron in the upper state through collisions with a foreign atom. Objections to this are now raised and the proposed mechanism of production of the bands is critically examined. L. S. G.

535.343.4 : 621.317.352.029.64 80

Water vapor absorption of electromagnetic radiation in the centimeter wave-length range. BECKER, G. E., AND AUTLER, S. H. *Phys. Rev.*, **70**, 300–7 (*Sept.* 1 *and* 15, 1946).—The absorption line resulting from the rotational transition $5_{-1} - 6_{-5}$ has been investigated experimentally. Radiation is fed into an air-filled cubical copper cavity of 8 ft edge. Strings of thermocouples with alternate junctions coated with a "lossy" material are placed at random in the cavity. The e.m.f. of these thermocouples is proportional to the *Q* of the cavity and its contents [see Abstr. 72 (1947)]. With the total pressure inside the cavity at one atmosphere, the partial pressure of the water vapour is varied from 1 mm to 55 mm of Hg. The change in e.m.f. with humidity yields a value for the losses in the water vapour; the *Q* of the cavity may be determined from measurements taken with an aperture in the side of the cavity. Results between 0·7 cm and 1·7 cm indicate a peak at $\bar{\nu} = 0{\cdot}744 \pm 0{\cdot}005$ cm^{-1} ($\lambda = 1{\cdot}34$ cm). At very low density, the ½-width of the curve (at ½-height) is $0{\cdot}087 \pm 0{\cdot}01$ cm^{-1}; for a density of 50 g/m^3 it is $0{\cdot}107 \pm 0{\cdot}01$ cm^{-1}. The cross-section for a water-water collision must be nearly 5 × that for a water-air collision to account for this change. The attenuation at the peak is 0·025 db/km for 1 g H_2O/m^3. A.

535.343.4 : 621.317.352.029.64 81

Atmospheric absorption measurements with a microwave radiometer. DICKE, R. H., BERINGER, R., KYHL, R. L., AND VANE, A. B. *Phys. Rev.*, **70**, 340–8 (*Sept.* 1 *and* 15, 1946).—The absorption of microwave radiation in traversing the earth's atmosphere has been measured at three wavelengths (1·00 cm, 1·25 cm and 1·50 cm) in the region of a water-vapour absorption line. The measurement employs a sensitive radiometer to detect thermal radiation from the absorbing atmosphere. The theory of such measurements and the connection between absorption and thermal radiation are presented. The measured absorption together with water-vapour soundings of the atmosphere permits the calculation of the absorption coefficients at standard conditions (293° K, 1 015 millibar). These are 0·011, 0·026 and 0·014 db/km/g H_2O/m^3 for the wavelengths 1·00 cm, 1·25 cm and 1·50 cm respectively, which are 50% greater than those given by the theory of Van Vleck. The collision width of the line and its location are in better agreement with the theory and infra-red absorption measurement. It is also found that there is very little (<20°K) radiation from cosmic matter at the radiometer wavelengths. A.

535.343.4–31 82

Ultra-violet absorption band-systems of SnSe and SnTe. VAGO, E. E., AND BARROW, R. F. *Proc. Phys. Soc., Lond.*, **58**, 707–17 (*Nov.*, 1946).—The study of the absorption spectra of SnSe and of SnTe [Abstr. 714 (1938), 1084 (1944)] has been extended to cover the ultra-violet region down to 2 100 Å. New systems of both molecules have been analysed vibrationally. The results, including those derived from the D–X systems already known, are given in tables. A.

535.37 83

Light storage in infra-red sensitive phosphors. ELLICKSON, R. T. *J. Opt. Soc. Amer.*, **36**, 501–2 (*Sept.*, 1946).—From experiments on samples of different thickness the amount of stored light in a particular sample of the infra-red sensitive phosphor made by activating Sr sulphide with Ce and Sm is calculated to be $2{\cdot}6\times10^{16}$ quanta per cm^3. This corresponds, for this sample, to one quantum of light for every 8 Sm atoms or every 60 Ce atoms. A.

535.37 84

Decay in brightness of infra-red sensitive phosphors. ELLICKSON, R. T., AND PARKER, W. L. *Phys. Rev.*, **70**, 290–9 (*Sept.* 1 *and* 15, 1946).—An equation is derived for the decay under constant i.r. stimulation, based on a second-order process, but taking into account the absorption of the stimulating i.r. and the emitted visible light. The theoretical curves obtained differ markedly from the simple second-order decay

rve, especially when the i.r. absorption > the visible. ıe equation involves three arbitrary constants pending on the quantum efficiency, the number of tive centres, and the visible and i.r. absorption efficients of the phosphor. The equation is shown fit the decay curve of a Sr selenide phosphor for effective decrease in brightness of 10^5. It is shown at theories involving a distribution of electron traps, th or without interaction, lead to conclusions that not agree with experiment. Some experimental idence is offered indicating that there is no change the trap distribution as this phosphor is exhausted. ıe apparent deepening of the traps as the decay ocess continues can be attributed to the i.r. absorp-ın. A.

5.371 85

Polarization of photoluminescence of uranium sses. SEVCHENKO, A. N. *J. Phys., USSR*, **8** o. 3) 163–70 (1944).—Boron, boron-silicate, basic icate and phosphate uranium glasses were ex-nined. It was found that the polarization depends the composition of the glass and on the wavelength the exciting light, and that it falls off with the cay of the luminescence. This decrease shows that e energy of excitation is transmitted from the cited to the unexcited molecules due to the existence quantum-mechanical resonance. The absorption d emission of radiation by uranium in glass and solutions is due to electric dipoles. L. S. G.

5.371 : 621.327.43 86

The fluorescence of phosphors in rare gases. BEESE, C. *J. Opt. Soc. Amer.*, **36**, 493–8 (*Sept.*, 1946).—periments were performed to investigate the ssibility of using rare gases as a substitute for Hg pour in fluorescent lamps. All phosphors showed torescence but efficiencies were low compared to g, Zn silicate phosphors being the brightest. fficiencies were highest at pressures too low for mmercial lamps except in the case of certain ixtures, but the efficiency of the Hg lamp was only alled for a pink lamp containing Ne. Several teresting relationships with the atomic number of e gas were found. A.

5.371 = 4 87

On the study and interpretation of the fall in sulphide sphorescence. SADDY, J. *C.R. Acad. Sci., Paris*, **2**, 1002–4 (*April* 24, 1946) *In French.*—A phos-toroscope was used to extend former work on nS . Cu excited by ultra-violet [ibid. **219**, 314–15 944)]. The decay between 2 sec and 2½ hours is presented to within 1% by the sum of 6 exponential rms, each with 2 constants determined respectively the mean life of electrons in a metastable level, and e initial number of centres of that kind. As in nS . Bi, the most numerous centres are those with a ean life of the order of minutes. S. T. H.

5.376 = 4 88

Electrophotoluminescence. DESTRIAU, G., AND OBERT, L. *Ann. Phys., Paris*, **17**, 318–23 (*June-ly–Aug.*, 1942) *In French.*—Many previous investi-tions [Abstr. 1806 (1940)] on the excitation of minescence by varying electric fields have estab-hed the formula $E = A.H.^n e^{-B/H}$ where A, B, n e constants ($n \simeq 2$) and H the field. This is entical with the formula for the Lilienfeld effect and for the conductivity effect in an electric field. The relation between the brilliance E and the temperature T has been given as $E = a\,e^{-b/T}$ but the analogy with the conductivity effect suggests the law $E = a\,T^{-m}\,e^{-b/T}$. Experiments have been carried out to test this with luminescent ZnS in cylindrical cells with electrodes a few tenths mm apart, and lead to the result that the facts are best represented by $E = AH^2 \exp\left(\frac{\delta}{T-\tau}\cdot\frac{1}{H}\right)$ where δ and τ are constants. J. E.

535.377 : 537.312.6 89

The thermoluminescence and conductivity of phosphors. HERMAN, R. C., AND MEYER, C. E. *J. Appl. Phys.*, **17**, 743–8 (*Sept.*, 1946).—A simple theoretical treatment is given for the emission of light and associated variations of dark current that occur on warming ZnS and $ZnSiO_3$ type phosphors previously irradiated with u.v. light at low temperatures. Good agreement is found between the calculated and observed glow curve for willemite. The same treatment is applied to the case of i.r. illumination of phosphors at low temperatures. A.

535.39 90

A reflectance measuring attachment for the Beckman spectrophotometer. PRIDE, G. E. *J. Opt. Soc. Amer.*, **36**, 510–13 (*Sept.*, 1946).

535.39 : 535.321 : 535.341 91

Note on the calculations of optical constants. PRICE, D. J. *Proc. Phys. Soc., Lond.*, **58**, 704–6 (*Nov.*, 1946).—A new equation, suitable for routine computation, is developed for the calculation of the optical constants of an absorbing medium from the polarization produced in a beam of light reflected from the surface. A.

535.39 = 82 92

Supplementary tables for I. V. Obreimov's graphical method for the determination of the thickness and refractive index of thin films on glass. BRONSHTEIN, E. *J. Exp. Theor. Phys.*, **16** (*No.* 3) 259–65 (1946) *In Russian.*—The tables are compiled for glasses with a r.i. of 1·47–1·72 and films with a r.i. of 1·2–1·55 [see *J. Exp. Theor. Phys.*, **14** (*Nos.* 10–11) 1944]. A.

535.41 : 531.51 = 4 93

Interferometric study of the movements of optical images. DURAND, E. *Ann. Phys., Paris*, **1**, 216–31 (*March–April*, 1946) *In French.*—It is shown that all displacements of images caused by movements of the source or the apparatus can be calculated from a consideration of interference between two beams with different frequencies. It follows that Abbe's sine rule is linked with the Doppler–Fizeau effect. This view of optical images unifies such phenomena as aberration of light and the influence of a gravitational field on the frequency of a light source. N. C.

535.412 94

Low-order multiple-beam interferometry. TOLANSKY, S. *Proc. Phys. Soc., Lond.*, **58**, 654–62 (*Nov.*, 1946).—A discussion is given of the various factors affecting the intensity and sharpness of the multiple-beam Fizeau fringes and fringes of equal chromatic order used for the study of surface topography. The effects of absorption in the Ag film, phase condition, linear displacement of the beams, finite size of source,

departure from parallelism and source line width are considered. It is shown that Fabry–Perot fringes, multiple-beam Fizeau fringes and fringes of equal chromatic order have all the same fringe shape if certain conditions are fulfilled. A.

535.42 : 532.72 *see Abstr.* 39

535.42 : 535.321 = 82 *see Abstr.* 69

535.8 : 535.317.4 = 82 *see Abstr.* 67

HEAT 536

536.081.4 : 536.48 : 536.423.15 *see Abstr.* 103

536.2 95

A new form of chart for determining temperatures in bodies of regular shape during heating or cooling. EDE, A. J. *Phil. Mag.*, **36**, 845–51 (*Dec.*, 1945).—The charts relate to the following cases: (1) infinite solid bounded by two parallel planes, (2) infinite bar, (3) a brick, (4) infinite circular cylinder, (5) finite cylinder, (6) sphere. In each case the body is initially at a uniform temperature and is suddenly transferred to surroundings at a different constant temperature. The charts given enable the mean- and centre-temperatures at any time to be obtained. L. S. G.

536.2 : 517.836 = 397 96

Solution of certain heat conduction problems by Abel's integral equation. KNUDSEN, H. L. *Tekn. Tidskr.*, **76**, 797–800 (*Aug.* 17, 1946) *In Swedish.*—Kelvin's method of images is extended to the case where the temperature of the source is a known function of time. The temperature field around a plane source is then determined from an integral equation of Abel's type. An example shows the application to the short-circuit heating of a cable. J. A. W.

536.2.02 : 534.121.2 : 532.5.032 : 517.65 *see Abstr.* 4

536.2.02 = 82 97

A problem in the theory of heat conduction in solid bodies. RUSHKIN, V. S. *J. Tech. Phys., USSR*, **16** (*No.* 2) 181–8 (1946) *In Russian.*—Heat is conducted into a semi-infinite body through the area of a circle, the rest of the surface being thermally insulated. The problem of how stationary conditions are reached after the commencement of heat flow is discussed. D. S.

536.2.02 = 82 98

Temperature distribution in an isotropic medium with a moving heat source. SHEVELJKOV, V. L. *J. Tech. Phys., USSR*, **16** (*No.* 2) 207–14 (1946) *In Russian.*—A solution of the differential equation for heat conduction is given when a source of heat moves in an isotropic medium, and approximations suitable for particular cases are indicated. D. S.

536.2.083 = 5 99

The measurement of thermal conductivity up to 1 300°C. CODEGONE, C. *Ric. Sci. Ricostruz.*, **16**, 286–9 (*March–April*, 1946) *In Italian.*—The apparatus previously described [Abstr. 4612 (1939)] for the measurement of the thermal conductivity of refractories served for temperatures below 1 000°C only. An apparatus to cover the range up to 1 300°C is described, in which the sample, a refractory consisting mainly of silica and alumina, density 1 870 kg/m³ and porosity 28·5%, is shaped into a hollow sphere of inner and outer diameter 15 and 30 cm respectively. An electric heater within the cavity provides the thermal flux, and thermocouples embedded in the refractory at various distances from the centre of the sphere determine the thermal gradient. For the range 230°C to 1 330°C the thermal conductivity is given by

$$\lambda_t = 0{\cdot}84 + 0{\cdot}88 \,.\, 10^{-3}t - 0{\cdot}22 \,.\, 10^{-6}t^2$$

watt/m°C. S. W.

536.212.3 = 82 100

A method for measuring thermal properties of insulators with disperse structure. CHUDNOVSKIJ, A. F. *J. Tech. Phys., USSR*, **16** (*No.* 2) 231–4 (1946) *In Russian.*—A method for rapid determination of the thermal conductivity and specific heat of insulators with a disperse structure (powders, etc.) is described. Non-stationary conditions between two co-axial cylinders are used. D. S.

536.212.3 = 82 101

Methods of investigating the thermal characteristics of soil. CHUDNOVSKIJ, A. F. *J. Tech. Phys., USSR*, **16** (*No.* 2) 243–9 (1946) *In Russian.*—Various forms of heat sources (cylinders, plates) in the investigation of thermal properties of soil are compared, and it is shown that a cylindrical source has certain advantages. D. S.

536.212.3 = 82 102

Contact method for measuring thermal properties of solid insulators. CHUDNOVSKIJ, A. F. *J. Tech. Phys., USSR*, **16** (*No.* 2) 249–55 (1946) *In Russian.*—Using non-stationary conditions of heat flow between a standard material in contact with the insulator to be studied, the thermal properties of the insulator can be measured in terms of those of the standard. Experimental details are given. D. S.

[536.413 + 536.613 + 536.75] : 532.7 : 548.0 *see Abstr.* 175

536.423.15 : 536.48 : 536.081.4 103

The vapour pressure of liquid helium from the λ-point to 1·3°K. KISTEMAKER, J. *Commun. K. Onnes Lab., Leiden* (*No.* 269c). *Physica, 's Grav.*, **12**, 272–80 (*Aug.*, 1946).—Vapour pressures have been determined from the λ-point to 1·3°K and compared with the results of measurements of isotherms in the same region [Abstr. 2866 (1946)]. A provisional table with corrections to the 1937 temperature scale [Abstr. 252 (1938)] has been deduced from them, giving a negative deviation from the 1937 scale at the λ-point of 0·013 of a degree which decreases linearly to zero at 1·55°K. From there on, a close agreement with Bleaney and Simon's scale [Abstr. 4108 (1939)] seems probable. A discussion of the possible errors in Keesom and Schmidt's measurements [Abstr. 252 (1938)] is given. A.

536.44 : 532.74 *see Abstr.* 40

536.48 : 536.081.4 : 536.423.15 *see Abstr.* 103

536.48 : 536.655 *see Abstr.* 106

536.48 : 539.893 104

Measurements at low temperatures and high pressures. I. Method for obtaining high pressures at low temperatures. LASAREW, B., AND KAN, L. *J. Phys.*,

SSR, 8 (*No.* 4) 193–200 (1944).—The method pends on the property of a number of substances g. H_2O, Bi, Sb, Ga) of increasing in volume when anging from the liquid to the solid state. An paratus for obtaining uniform pressures up to 750 kg/cm² at the temperatures of liquid He by ing water was constructed. A simple device was veloped for measuring the pressure according to the stic extensions of the apparatus. Pressures up to out 10^4 kg/cm² may be obtained if Bi or Ga is used. e apparatus may be used for measuring super-nductivity and electrical conductivity at the tem-rature of liquid He. L. S. G.

6.52 : 535.23.08 : 621.317.39 105

Use of lead sulphide photo-conductive cells for high-ed pyrometry. Lee, E., and Parker, R. C. *ture, Lond.*, **158**, 518 (*Oct.* 12, 1946).—The peak sponse of the cells is at 2·7 μ, and the threshold at 5 μ; if the radiation is mechanically interrupted and tuned amplifier used, 10^{-9} W of radiation can be tected with a response time of 30 msec or correspondingly less with shorter response time. The sponse time of the cells themselves is 0·1 msec. is sensitivity is adequate for pyrometric measure-nts of bodies at temperatures as low as 100°C ack body radiation between 1 and 3 $\mu \Rightarrow 1{\cdot}2\times 10^{-4}$ W/cm²). The oscillographic recording of tem-rature changes of a railway tyre when braking is scribed.

6.521.089.6 : 621.326.4 : 535.241.33 *see Abstr.* 63

6.55 : 535.338.4 *see Abstr.* 76

6.55 : 545.822 : 535.338.35 : 535.33.03 *see Abstr.* 70

36.613 + 536.75 + 536.413] : 532.7 : 548.0 *see Abstr.* 175

6.655 : 536.48 106

The vaporisation heat of liquid helium from 0 to 2°K and the value of *h*, calculated from the thermo-namical behaviour of helium. Kistemaker, J. *mmun. K. Onnes Lab., Leiden* (*Suppl. No.* 95). *ysica, 's Grav.*, **12**, 281–3 (*Aug.*, 1946).

THERMODYNAMICS 536.7/.8

6.7 : 535.234 *see Abstr.* 62

6.71 : 533.75 *see Abstr.* 46

36.75 + 536.613 + 536.413] : 532.7 : 548.0 *see Abstr.* 175

6.8 : 621.577 107

The value of heat with special reference to the heat mp. Faber, O. *Proc. Instn Mech. Engrs, Lond.*, 4, 144–78 (*Sept.*, 1946).—Abstr. 228 B (1946)].

ELECTRICITY 537

7.11 : 538.3 108

The experimental basis of electromagnetism: the ect-current circuit. Campbell, N. R., and RTSHORN, L. *Proc. Phys. Soc., Lond.*, **58**, 634–53 (*Nov.*, 1946).—The purpose of the inquiry, of which this paper forms the first part, is to show to what extent the working principles of electromagnetism can be soundly based on real experimental facts—i.e. on experiments that have actually been performed with an accuracy that would be regarded as significant to-day. Beginning with an outline of the general principles of measurement, current, resistance, conductance and voltage are established independently of a knowledge of any other magnitudes; Ohm's law and the conception of e.m.f. follow. An examination of the relations between these magnitudes and the geometrical and mechanical magnitudes then leads to theoretical conceptions like potential, and to a consideration of the status of Ampère's two laws. That for the force between two circuits is well established and defines the unit of current. That for the torque on a compass needle near a circuit is less well established; but it leads to the recognition of H in a non-magnetic medium as a defined magnitude, whose significance is found to be independent of the existence of magnets. A.

537.122 : 530.14 *see Abstr.* 25

537.133 : 530.145 *see Abstr.* 28

537.212 : 537.226 = 3 *see Abstr.* 109

537.226 : 537.212 = 3 109

On the theory of the internal electrical field strength. Böttcher, C. J. F. *Physica, 's Grav.*, **9**, 937–44 (*Dec.*, 1942) *In German.*—Using an equation previously obtained [Abstr. 3367 (1938)] a new formula is derived for the internal field in a gaseous or liquid dielectric in which a homogeneous field prevails. In general, the mean internal field in the spaces occupied by the molecules is greater than in the interstices, and in the case of a mixture has considerably different values for the different kinds of molecules. The mean value (in space) of the internal field is, however, exactly equal to Lorentz's expression $\mathbf{F} = \mathbf{E} + \frac{4}{3}\pi\mathbf{P}$. This is in complete agreement with the restrictions under which the derivation of Lorentz's formula applies. A.

537.226 : 538.213 110

The effective permeability of mixtures of solids. Polder, D., and van Santen, J. H. *Physica, 's Grav.*, **12**, 257–71 (*Aug.*, 1946).—The effective permittivity is calculated for a material, consisting of a medium in which ellipsoidal solid particles or empty holes with various permittivities are packed together. The calculation is based on an approximation which in the case of spherical particles gives results identical with Böttcher's method [Abstr. 109 (1947)]. The effect of the shape of the ellipsoids is discussed. A.

537.226 : 621.396.11 111

On the variation of the electrical constants of soil with the frequency of the measuring field. Khastgir, S. R. *Curr. Sci.*, **15**, 188–90 (*July*, 1946).

537.226.8 : 548.0 = 4 112

The dielectric properties of the phosphate and the sulphate of ammonium at low temperatures. Guillien, R. *Ann. Phys., Paris*, **17**, 334–6 (*June–July–Aug.*, 1942) *In French.*—The permittivity and the electric absorption of $NH_4H_2PO_4$ are low and nearly constant between 70° and 149°K, where there is a sudden increase. This behaviour is not analogous to

the Curie points of KH_2PO_4. The same properties of $(NH_4)_2SO_4$ increase gradually in the range 150° to 222°K, where there is a sudden decrease to values almost constant in the range 225° to 240°K. Data for various frequencies are given graphically. A. J. C. W.

ELECTRIC CURRENTS 537.3

537.311.33 : 538.639 : 537.312.5 = 82 *see Abstr.* 116

537.311.37 : 551.594.13 : 537.568 *see Abstr.* 131

537.311.4 113

On the theory of electric contacts between metallic bodies. FRENKEL, J. *J. Phys., USSR*, **9**, 489 (1945).—Electrons penetrate the gap between two bodies by thermo-electric emission; image forces lower the potential barriers by an amount inversely proportional to the width of the gap. Thus the electrical conductivity of fine metallic powders and granular films rises with temperature in a way similar to semiconductors. A.

537.312.5 : 621.383.5 114

Fatigue in selenium barrier layer photocells. HOUSTOUN, R. A. *Phil. Mag.*, **37**, 13–17 (*Jan.*, 1946).—A continuation of previous work [Abstr. 79 (1942)] in the light of the author's theory [Abstr. 725 B (1942)] of the selenium cell. The current is connected with the incident light by the formula $I^{-1} = k(1 + Rr^{-1})/EL + R/E$, where I is the current and L the light intensity. Experiments are now described showing how the constants of the formula are affected by fatigue. Preston's explanation of the fatigue [Abstr. 1809 B (1944)] is discussed and criticized. L. S. G.

537.312.5 = 82 115

Contribution to the theory of photo-electric conductivity of allochromatic crystals. RUIZHANOV, S. *J. Exp. Theor. Phys.*, **16** (*No.* 3) 229–45 (1946) *In Russian.*—Expressions are derived for the displacement with temperature of the frequency of the selective maximum for the F and V bands, assuming that the photo-electric conductivity is related to a direct transition of the electrons into the dielectric conductivity band. Electron displacement and its temperature dependence is discussed. A.

537.312.5 : 537.311.33 : 538.639 = 82 116

The influence of a magnetic field on the photoconductivity of semi-conductors. KIKOIN, I. K., AND SIMONENKO, D. L. *J. Tech. Phys., USSR*, **16** (*No.* 2) 155–8 (1946) *In Russian.*—An experimental method is described for investigation of photo-conductivity of copper oxide, a thin plate of which is cooled with liquid nitrogen in a Dewar flask. Though the "black level" conductivity is negligible, the photoconductivity was found to drop about 20% with the application of a magnetic field. A. L.

537.312.6 : 530.12 117

A relativistic determination of the relation between electrical resistance and temperature. DINGLE, H. *Phil. Mag.*, **37**, 58–64 (*Jan.*, 1946).—The theory of Abstr. 62 (1947) is used to deduce the law $\rho_T = \rho_0(1 + \alpha T)$, for the resistance ρ of a pure substance, where T is the temperature on the Centigrade scale and $\alpha = 0{\cdot}00366$. The deduction of this result is the analogue of the derivation of the dependence of mass on velocity in the special theory of relativity, and it follows from the necessity of preserving a certain law through co-ordinate transformations. L. S. G.

537.312.6 : 535.377 *see Abstr.* 89

537.312.62 : 535.23.08 *see Abstr.* 61

537.312.62 : 537.321 *see Abstr.* 118

537.312.62 : 538.242 = 82 *see Abstr.* 139

537.321 : 537.312.62 118

On the thermo-electric phenomena in superconductors. GINSBURG, V. L. *J. Phys., USSR*, **8** (*No.* 3) 148–53 (1944).—The equations satisfied by the superconducting current, $\mathbf{j}^s$, and the normal current, $\mathbf{j}^n$, in a homogeneous isotropic superconductor without a temperature gradient are written down, and these equations are generalized to include the case of a gradient in the temperature and in the thermodynamic potential. An analysis, based on these equations, shows that a normal current must always exist in a superconductor with a temperature gradient and that a superconducting current appears at the same time to compensate the normal current. Thus no observations may be made. But the thermo-electric effects are different in the case of an anisotropic homogeneous superconductor (e.g. a crystal), and the problem of an infinite superconducting plate with a temperature gradient is analysed. The distribution of the field and current within the plate are calculated. The resulting current $\mathbf{j} = \mathbf{j}^s + \mathbf{j}^n$ does not vanish in this case and it should be possible to detect the thermal current. L. S. G.

537.322.4 119

The thermo-electric properties of conductors. GUREVICH, L. *J. Phys., USSR*, **9**, 477 (1945); **10**, 67 (1946).—A new mechanism for the production of a thermo-electric e.m.f. (E_{th}) is proposed, depending upon the transference of electrons by a stream of "phonons" caused by the temperature gradient. $E_{th} \propto T^{-1}$ at high temperatures, T^3 at low. Over a wide temperature range the thermo-e.m.f. considerably exceeds the normal one, and the transition from one type of mechanism of formation to the other may explain numerous anomalies in conductors. A.

ELECTRIC DISCHARGES AND RADIATIONS 537.5

537.523.5 120

Convection velocity in a direct current arc. VAN STEKELENBURG, L. H. M. *Physica, 's Grav.*, **12**, 289–95 (*Aug.*, 1946).—The convection velocity of the gas in the centre of a vertical direct current arc was determined by measuring the velocity of small carbon particles carried in it photographed at intervals of 1/250 sec. The mean velocity of the gas was found to be about 1 m/sec, and to depend on the strength of the electric current and on the height above the lower electrode. Neither the direction of the current nor the length of the arc affected the gas velocity perceptibly. A.

537.525 121

Ionization currents in non-uniform electric fields. MORTON, P. L. *Phys. Rev.*, **70**, 358–66 (*Sept.* 1 *and* 15, 1946).—It is demonstrated that calculation of the ionization current in a gaseous discharge by means of the classical Townsend equation $i = i_0 \exp.(\int \alpha dx)$ is likely to lead to large errors when the field distribution is not uniform. For a field approximately inversely proportional to distance from the cathode, the error was found to be >25% when the field intensity changed by >2·5% per mean free path of electrons just able to ionize. For fields of the type found at the cathode end of a glow discharge, therefore, the Townsend equation is seldom, if ever, applicable. A differential-difference equation for the electron current as a function of the electron energy and distance from the cathode was derived, and, by the use of semi-empirical functions where adequate data are not available, the ionization currents were calculated by step-by-step numerical methods for a restricted range of pressure and applied voltage. The results agree with measured currents within the range where the assumed functions apply. A.

537.525 122

Energy distribution of electrons in high frequency gas discharges. HOLSTEIN, T. *Phys. Rev.*, **70**, 67–84 (*Sept.* 1 *and* 15, 1946).—In this paper an equation for the energy distribution of electrons in a gas subject to a spatially constant high frequency field is obtained. The domain of applicability of the equation is limited (*a*) to situations in which the densities of electrons, ions and excited molecules are very small compared to the density of normal molecules; (*b*) to electron energies such that the elastic collision cross-section for electron-molecule collisions is large compared to the inelastic cross-section; (*c*) to linear dimensions of the discharge region large compared to the mean free path for elastic collision; and (*d*) to frequencies of the impressed electric field larger than a certain lower limit determined by the pressure, type of gas and linear dimensions of the discharge region. The distribution equation for the d.c. case is also derived; it agrees with those obtained by other authors. A comparison of the high frequency and d.c. distribution equations suggests a useful correlation between the two cases. A.

537.525 : 621.385.18 123

Initiation of discharge in arcs of the thyratron type. MULLIN, C. J. *Phys. Rev.*, **70**, 401–5 (*Sept.* 1 *and* 15, 1946).—When a grid overvoltage is applied to a thyratron, the resulting electron current produces positive ions which move back toward the cathode of the tube. Some of these ions are "trapped" in the potential well formed near the cathode by the electron space charge, and diminish its depth, thus permitting a larger current to be emitted from the cathode. When the number of ions trapped in the well becomes sufficient to decrease its depth to zero, the saturation value of the cathode current is emitted, and the initiation of the discharge is completed. From this model, an equation for the anode current as a function of time during the initiation has been derived, which yields current *v.* time curves in good agreement with experiment. From this equation, estimates of the ionization time can be made. The calculations give ionization times of the correct order of magnitude. The calculated ionization times show the experimentally observed dependence upon the grid overvoltage, gas pressure and anode voltage. A.

537.533.72 124

The paths of ions and electrons in non-uniform crossed electric and magnetic fields. COGGESHALL, N. D. *Phys. Rev.*, **70**, 270–80 (*Sept.* 1 *and* 15, 1946).—The integration of the force equations for a charged particle moving in the presence of particular types of crossed, non-uniform, electric and magnetic fields is shown to be possible in a very simple manner. These types of field, which are enumerated, are only met with on a median plane symmetrically situated relative to magnetic pole faces and electrostatic electrodes. The equations are solved and discussions made of the orbits for several different field arrangements; for one a new type of perfect focusing is found. The method can be used with numerical integration. A.

537.533.72 = 4 125

Practical limitation of the corpuscular microscope. DE BROGLIE, L. *C.R. Acad. Sci., Paris*, **222**, 1017–19 (*April* 29, 1946) *In French.*—The effect of motion of the object brought about by electron impact in the electron microscope can make it impossible to obtain a sharp image if the object is sufficiently small and light. A. J. M.

537.533.72 : 535.336.2 = 3 126

Theory of mass spectrographs which are double focusing for all masses. KLEMM, A. *Z. Naturforsch.*, **1**, 137–41 (*March*, 1946) *In German.*—A theoretical treatment of the focusing properties of the Mattauch type of mass spectrograph is given. W. E. D.

537.533.73 127

Refraction effects in electron diffraction. COWLEY, J. M., AND REES, A. L. G. *Nature, Lond.*, **158**, 550–1 (*Oct.* 19, 1946).

537.533.74 = 82 128

Single scattering of fast electrons in aluminium. PERRIMOND, I. *J. Exp. Theor. Phys.*, **16** (*No.* 4) 306–15 (1946) *In Russian.*—An intense beam of electrons from Ra(B + C) was produced by means of a magnetic spectrograph with short coils. The degree of monochromatization was about 10%. The coils were iron-shielded to prevent penetration of the magnetic field into the scattering chamber. Electron energies up to 2·5 eMV and above were obtainable over an unlimited period. The specially designed box enabled the scattering to be studied under carefully controlled conditions. The angular distribution of electrons from 60° up to 120° at $E = 0{\cdot}76$ and 1·5 eMV and from 60° to 130° at $E = 1{\cdot}0$ eMV showed full agreement with Mott's theoretical values. The dependence of the intensity of scattering on atomic number for Al and C also agreed with theory, and the absolute value of the effective cross-section for scattering in Al at $E = 1{\cdot}5$ eMV did not differ from the theoretical value by >1·5 times. A.

537.533.8 = 4 129

Absorption of secondary electrons by thin screens. SAULNIER, A. *C.R. Acad. Sci., Paris*, **222**, 876–8 (*April* 8, 1946) *In French.*—A sheet of Pb, 0·02 cm thick, is placed in contact with a screen under test, and an X-ray film is placed with its emulsion adjacent to the screen. When the Pb is exposed to a beam of

X-rays, secondary electrons are emitted. The extent of their absorption by the screen is determined by the blackening of the film. A. J. M.

537.533.8 = 82 130

Secondary electron emission of thin films of alkali halides. ZERNOV, D. V., AND KULVARSKAJA, B. S. *J. Tech. Phys., USSR*, **16** (*No.* 1) 71–82 (1946) *In Russian.*—It is shown that the secondary emission coefficient of KCl does not exceed 10, i.e. is of the same order as that of caesium oxide cathodes, and that much higher values observed by some investigators are due to auto-electron emission by the field formed in the film. Several experimental curves are presented. A. L.

537.568 : 551.594.13 : 537.311.37 131

Experiments on the conductivity of atmospheric air. NOLAN, P. J., AND FAHY, E. F. *Proc. R. Irish Acad. A*, **50**, 233–56 (*Nov.*, 1945).—Schweidler gave two methods [Abstr. 1006, 1316 (1920), 1462 (1925)] for determining the dissipation coefficient, β, of small ions in impure air. These methods yield very different values, and experiments are described which investigate the discrepancy. The current/potential relation for pure air in a large cylindrical vessel is examined, and it is found that the relation between i/E and i in one method is not linear. The effects of columnar ionization and of convection are discussed in connection with the linear relation reported by earlier workers. A series of measurements are made of the combination coefficients of small ions and nuclei just after enclosure. The ratio of these coefficients with nuclei of positive and negative small ions is 1 : 21. Nuclei enclosed during fogs are discussed briefly. L. S. G.

537.568 : 621.385.28 132

Physical processes in the recovery of TR tubes. MARGENAU, H., MCMILLAN, F. L., JR., DEARNLEY, I. H., PEARSALL, C. S., AND MONTGOMERY, C. G. *Phys. Rev.*, **70**, 349–57 (*Sept.* 1 *and* 15, 1946).—The recovery of gas-filled switching (TR) tubes, i.e. the elimination of ions on termination of the discharge, is of great interest because it determines the quality of radar reception. In the first part of this paper, techniques of measurement of the recovery of certain types of TR tubes are described and results are reported. In the second part, the physical processes responsible for recovery are discussed in connection with simple theoretical developments concerning recombination of electrons and positive ions, diffusion of electrons, and capture of electrons by gas molecules. The last of these processes is found to be of principal importance in removing electrons and producing a short recovery time. A.

COSMIC RAYS 537.591

537.591 133

An observed abnormal increase in cosmic-ray intensity at Lahore. SARNA, H. R., AND SHARMA, O. P. *Nature, Lond.*, **158**, 550 (*Oct.* 19, 1946).—The counting rate with a triple coincidence counter system was observed to increase about 2½ times, both in the vertical direction and at 20° W, for a few hours on Aug. 3, 1946.

MAGNETISM 538

538.113 : 539.154.3 134

Feeble paramagnetism of hexavalent chromium. DATAR, D. S., AND DATAR, S. S. *Nature, Lond.*, **158**, 518–19 (*Oct.* 12, 1946).

538.12 135

A closer approximation to the theory of the field of the Gerlach–Stern magnets. DAVY, N. *Phil. Mag.*, **36**, 852–9 (*Dec.*, 1945).—An approximate theory of the field is given for a magnet with a wedge-shaped pole-piece facing a slotted one. This is the exact theory of a 2-dimensional system in which the wedge is replaced by a semi-infinite thin plate with a sharp edge. The edge faces the slotted pole-piece and the slot is of finite depth as in the actual case. A Schwarz–Christoffel transformation is used. Intensities of magnetization, field strengths and gradients useful in molecular beam work are obtained. Diagrams are given of the field of force both in the 2-dimensional system and in the actual magnet. L. S. G.

538.12 = 4 136

Magnetic separation of diamagnetics or paramagnetics, and the production of fields of high gradient. COTTON, A., AND TSAI, B. *Ann. Phys., Paris*, **17**, 337–59 (*Sept.–Dec.*, 1942) *In French.*—Para- and diamagnetic particles in a non-uniform magnetic field experience a mechanical force proportional to $(K_1-K_2)\partial H^2/\partial z$ in the direction OZ, where K_1 is the susceptibility of the particle and K_2 that of the surrounding medium. By using liquid oxygen as a medium the separation at different levels of particles of various elements and compounds (e.g. Bi, C, S, ferrous ammonium sulphate, chrome alum) is demonstrated using a large electromagnet giving values of $H\partial H/\partial z$ up to 10^8. While admitting that the method has obvious practical limitations, the authors point out that it can be usefully employed, for example in the separation of salts of the rare earths, and in measuring susceptibilities. The second part of the paper reviews methods for the production of fields giving large values of $H\partial H/\partial z$, and draws attention to the dimensional relationship which leads to the conclusion that if the whole equipment is scaled down by a factor k, then the force on a given volume of specimen is increased k times. Two types of small permanent magnet are described (the maximum dimension is shown as 110 mm) with which values of $H\partial H/\partial z$ of over 10^8 can be obtained. N. F. A.

538.213 137

Theory of the dispersion of magnetic permeability in ferromagnetic materials at microwave frequencies. KITTEL, C. *Phys. Rev.*, **70**, 281–90 (*Sept.* 1 *and* 15, 1946).—The transition in the value of the initial magnetic permeability of Fe and Ni from the d.c. permeability ~100 to the infra-red permeability ~1 is known to occur principally in the microwave frequency range. An explanation of the experimental facts is proposed by considering the equations of motion of a domain boundary in an applied magnetic field for frequencies such that the skin depth of the magnetic field is smaller than the thickness of a domain. An analytic solution of Maxwell's equations is found for the magnetization of a layer one domain thick. The definition of the permeability at

high frequencies is considered carefully, and it is shown that the natural definition leads to complex values for the permeability. In experiments, two different types of permeabilities are found. The relationship of the complex μ to the μ_R determined from resistive losses in a circuit element and to the μ_L determined from reactance changes is developed. A criticism is given of theories of ferromagnetic resonance. The status of Becker's theory of eddy current damping is considered. Several suggestions are made for further experiments. A.

538.213 : 537.226 *see Abstr.* 110

538.22 : 541.67 = 82 138

Magnetic properties and chemical nature of solid solutions of weakly magnetic elements in nickel and iron. DORFMAN, I. *J. Exp. Theor. Phys.*, **16** (*No.* 4) 349–60 (1946) *In Russian.*—A study of the magnetic properties above the Curie point of solid solutions of various metals at low concentrations in Ni showed that the individual chemical properties of these metals were important. Fresh light was thrown on the nature of chemical bonds in solid solutions. A.

538.242 : 537.312.62 = 82 139

Gyromagnetic effect in super-conductors. KIKOIN, I. K. *J. Tech. Phys., USSR*, **16** (*No.* 2) 129–54 (1946) *In Russian.*—The experimental technique of the measurement of the Einstein–de Haas effect in superconducting Pb is described in detail. The existence of the effect is established, and the numerical value found for the Landé-factor ($1 \pm 0{\cdot}03$) is shown to be due to closed electron currents, and not to electron spin. Difficulties arise in the interpretation of the effect, as the induced Foucault currents cannot penetrate to any depth because in a super-conductor $B = 0$; alternatively, it can be assumed that the observed diamagnetism is due to microscopic circular currents. A. L.

538.245 : 669.018 : 621.318.323.2 : 621.317.4 = 4 140

New method of studying ferromagnetics in weak a.c. fields: application to certain alloys. EPELBOÏM, I. *Rev. Gén. Élect.*, **55**, 271–8 (*July*); 310–24 (*Aug.*, 1946) *In French.*—In the first part of the paper the author discusses the behaviour of ferromagnetics in weak fields from the viewpoint of Rayleigh's equation $B = aH + bH^2$. The properties of the ferromagnetics are described in terms of dynamic permeability and loss angle, and the total loss is considered as made up of hysteresis, eddy losses and "magnetic viscosity." The anomalous high eddy losses observed are discussed, and the possible contributions of inhomogeneity to this anomaly are mentioned. The second part of the paper is devoted to measurements made on nickel-iron toroidal cores. The cores were tested in a demountable winding consisting of silver wires with plug and socket connections. Hay's bridge is used and it is discussed in some detail. Measurements were made at frequencies between 50 and 10 000 c/s, with fields from 0·5 to 32 millioersteds and at temperatures between 0 and 40°C. The author concludes that his results conform more closely to Rayleigh's law than to an alternative proposed by Sixtus. N. F. A.

ELECTROMAGNETISM . ELECTRODYNAMICS
538.3/.5

538.3 : 523.11 *see Abstr.* 14

538.3 : 530.145 *see Abstr.* 26

538.3 : 530.145.63 *see Abstr.* 29

538.3 : 537.11 *see Abstr.* 108

538.551.25 : 517.947.44 : 534.01 *see Abstr.* 47

538.561 : 621.396.611.4 141

Calculation of the electromagnetic field, frequency and circuit parameters of high-frequency resonator cavities. MOTZ, H. *J. Instn Elect. Engrs, Pt III*, 93, 335–43 (*Sept.*, 1946).—[Abstr. 181 B (1946)].

538.566 : 621.396.821 : 523.72 *see Abstr.* 17

538.566.3 : 621.396.11 142

Wave-treatment of propagation of electromagnetic waves in the ionosphere. SAHA, M. N., AND BANERJEA, B. K. *Indian J. Phys.*, **19**, 159–66 (*Oct.*, 1945).—Wave-equations for the propagation of e.m. waves through the ionosphere have been obtained by the use of a new mathematical method involving the use of dyadic analysis introduced by Gibbs. Expressions for steady current conductivity of the ionosphere have been obtained by this method, and the results are concordant with those of Chapman; an extra term for the conductivity, which is more prominent in the F_2 layer, has been obtained. The wave is split up into three waves, as in the Zeeman effect, one of which is ordinary, the other two extraordinary, in accordance with observation [Abstr. 4904 (1936)]. A.

538.614 : 548.0 = 3 143

Investigations of the magnetic rotation of the plane of polarization in crystals. GABLER, F. *S.B. Akad. Wiss., Wien*, **148**, *IIa* (*Nos.* 3–4) 111–47 (1939) *In German.*—The motion of an electron forming part of an optically-anisotropic medium traversed by a light wave whose direction of propagation coincides with that of a constant magnetic field is investigated, damping (absorption) being neglected. In a vanishingly-small field the light travels as two linearly-polarized plane waves with perpendicular vibration directions. Under the influence of the field each of these components broadens into an elliptical vibration, the ellipses being similar, but described in opposite senses and having major axes at right angles. Expressions are derived for the azimuth and phase angle of the emergent wave corresponding to an incident elliptically-polarized wave of arbitrary azimuth and phase angle. These are verified experimentally, a Kerr cell filled with nitrobenzene being used as the optically-anisotropic medium. The theory of the analyser used is treated in detail. The following values of the Verdet constant (rotation of the plane of polarization in minutes of angle per gauss per cm) were found in subsidiary experiments:

	$\lambda = 5\,461$ Å	$\lambda = 5\,893$ Å
Nitrobenzene	$0{\cdot}0260 - 0{\cdot}0000221t$	$0{\cdot}0220 - 0{\cdot}0000190t$
Jena Normalglas ..	0·0216	0·0186
Jena Duranglas	0·0183	0·0156
Jena Geräteglas 20 ..	0·0230	0·0195

the glasses being at 20°C and the equations covering the range 12° to 190°C. A. J. C. W.

538.639 : 537.311.33 : 537.312.5 = 82 *see Abstr.* 116

538.691 : 621.385.83 144

The stability of electron orbits in the synchrotron. FRANK, N. H. *Phys. Rev.*, **70**, 177–83 (*Aug.* 1 *and* 15, 1946).—[Abstr. 141 B (1947)].

ATOMIC AND MOLECULAR STRUCTURE 539

539.132 145

Electronic states and potential curves of diatomic molecules. VALATIN, J. G. *Proc. Phys. Soc., Lond.*, **58**, 695–700 (*Nov.*, 1946).—A co-ordination rule of discrete molecular energy terms cannot be deduced from the non-crossing of the energy eigenvalue curves of the two-centre model. Clear distinction is to be made between the potential curves of unperturbed electronic states and the energy eigenvalue curves of the two-centre problem, the approximate existence of potential curves being the consequence of the averageability of the interactions with respect to the electronic motions, which can also be influenced by the motion of the nuclei. A.

539.152.1 : 539.167.3 *see Abstr.*

539.153 146

Separable wave functions of the ground state of helium constructed from Hylleraas' wave function. KU, T. Z. *Chin. J. Phys.*, **6**, 21–6 (*July*, 1945).—The single-electron wave function of the ground state of the helium atom is obtained from the wave function of Hylleraas [Abstr. 2936 (1929), 734 (1930)] by integrating this over the co-ordinates of one electron. The energy of the ground state calculated with this wave function is −5·717 Rh, compared with −5·755 Rh, obtained by Hartree [Abstr. 2918 (1928)], using the self-consistent field method. L. S. G.

539.153 147

Hylleraasian wave function of $2s^{2\prime}S$ of helium. KOU, T. T., AND WU, T.-Y. *Chin. J. Phys.*, **6**, 50–8 (*July*, 1945).—A wave function of the Hylleraasian type is used to calculate the energy, which is found to be $E(2s^2\ {}^1S) = -1{\cdot}5412$ Rh, compared with the value −1·4400 Rh obtained by the self-consistent field method. L. S. G.

539.154.3 : 538.113 *see Abstr.* 134

RADIOACTIVITY . NUCLEAR DISINTEGRATION . NUCLEAR PARTICLES 539.16/.18

539.16.08 : 519.21 148

On the statistical treatment of counting experiments in nuclear physics. HOLE, N. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 2) *Paper* 11, 11 *pp.* (1946).—A general study of the counting of randomly distributed events. The recovery time (resolving time) of the counting apparatus is important, and formulae are given for the number of particles registered by two types of counter. The probability distribution of impulses recorded by a counter satisfies

$$\dot{M}(t) + ne^{-n\tau}M(t-\tau) = 0$$

where τ is the resolving time. The case where more than one counter is involved is also discussed. L. S. G.

539.163 149

The disintegration of Mn^{56}. SIEGBAHN, K. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 2) *Paper* 10, 11 *pp.* (1946).—The β-spectrum of Mn^{56} disintegrating to Fe^{56} has been investigated. The upper energy limit of the spectrum was determined by the Fermi method, but the problem cannot be completely solved by this means owing to the occurrence of γ-components. The γ-radiation was investigated by the photo-Compton method. Three γ-lines of energies 0·822, 1·77 and 2·06 eMV were detected, the intensity ratios being 10 : 3 : 2. There are three β-components with energies 2·81, 1·04 and 0·65 eMV, the intensity ratios being 2 : 3 : 5. The nuclear term scheme for the disintegration is given, and the mechanism of the disintegration is discussed. A. J. M.

539.163 : 539.172.3 *see Abstr.* 154

539.164.75 150

An attempt to measure the influence of the temperature on the stopping power of a metal for polonium α-particles. GERRITSEN, A. N. *Commun. K. Onnes' Lab., Leiden* (*No.* 270*b*). *Physica, 's Grav.*, **12**, 311–20 (*Aug.*, 1946).—Measurements with Al and Sn as stopping media showed no influence down to liquid helium temperatures. [See Abstr. 4481 (1933), 1891 (1946)]. A.

539.167.3 : 539.152.1 151

The disintegration of Cl^{38}. HOLE, N., AND SIEGBAHN, K. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 1), *Paper* 9, 10 *pp.* (1946).—The energies and intensities of the β- and γ-radiation emitted when Cl^{38} disintegrates have been investigated. LiCl was irradiated in a cyclotron with 6 eMV deuterons, and the active Cl was precipitated as AgCl. Examination of the decay curve showed that only one period (38·5 ± 0·5 min) was present, indicating the absence of any active substance other than Cl^{38}. The β-spectrum shows the presence of three components with the upper limits 5·2, 2·70 and 1·19 eMV. The photo-Compton method was used to investigate the γ-components, of which two were detected, with energies 1·60 and 2·12 eMV, respectively. The ratio of intensities is 43 : 57. The disintegration scheme is given. A. J. M.

539.167.3 = 3 152

Radioactive nuclei produced by irradiation of copper with deuterons. MEITNER, L. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 1) *Paper* 3, 12 *pp.* (1946) *In German.*—Irradiation of Cu with deuterons gives rise to Cu^{62}, Cu^{64}, Cu^{66}, Zn^{63} and Zn^{65}. Cu^{66} has a strong γ-radiation of energy 1·32 ± 0·04 eMV. A probable disintegration scheme is given. The energy thresholds for the processes $Cu^{63}(d, H^3)Cu^{62}$ and $Cu^{63}(d, 2n)Zn^{63}$ are not 7·0 and 7·5 eMV as formerly supposed; the most probable values are 5·2 ± 0·4 eMV and 5·5 ± 0·4 eMV. The existence of a γ-radiation stated by Townsend [Abstr. 560 (1941)] to be emitted from Zn^{63} could not be confirmed. A. J. M.

539.172.3 153

Multiple nuclear disintegrations induced by 100-Mev X-rays. BALDWIN, G. C., AND KLAIBER, G. S. *Phys. Rev.*, **70**, 259–70 (*Sept.* 1 *and* 15, 1946).—1 500 photographs taken with a 12 in cloud chamber filled with air and irradiated with high energy X-rays from a 100 eMV betatron, have yielded 105 single

protons of energies up to 9 eMV, 7 tracks showing a proton or α-particle and a heavy recoil nucleus, and 3 four-particle "stars," in two of which one α-particle, two protons, and a recoil nucleus can be identified. At least one neutron must accompany the observed particles in each multiple track to satisfy the momentum conservation law. In one star, a particle which may be of intermediate mass is observed as one of the disintegration products. No recoil protons in H_2 were observed in 150 photographs, indicating that fast neutrons are not present in sufficient intensity to cause the observed disintegrations. Identification of residual nuclei by measurement of the $\frac{1}{2}$-lives of radioactivity induced in irradiated samples has revealed many multiple disintegration processes. Strong activities were observed from (γ, p) and $(\gamma, 2n)$ reactions, moderately strong activities from (γ, pn), $(\gamma, 2p)$ and $(\gamma, 2pn)$. The reactions Mg^{25} $(\gamma, p)Na^{24}$ and $Pb^{206}(\gamma, pn)Tl^{204}$ have been established by chemical and β-decay evidence. Weak activities were observed which could be attributed to $(\gamma, p2n)$, $(\gamma, 3pn)$ and $(\gamma, \alpha n)$ or $(\gamma, 2p3n)$. Moderately strong activities in Al and P suggest the possibility of a nuclear process induced by quanta involving the loss of charge without change of mass. A.

539.172.3 : 539.163 154

Studies in nuclear physics. Excitation by means of X-rays. Activity of ^{87}Rb. EKLUND, S. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 2) *Paper* 14, 79 *pp.* (1946).—Details of the construction of a cascade-coupled h.t. unit providing a maximum voltage of 400 kV and of an accelerating tube used as an X-ray tube, are given. Methods of measurement of the h.t. voltage are described. The simplest and most accurate involves the use of an ohmic resistance of $10^9\,\Omega$, the resistance of which was determined to $\pm 0{\cdot}5\%$. The construction of a Geiger–Müller tube for the study of soft β-radiation from radioactive substances or from γ-radiation which has undergone internal conversion is described. Attempts were made to bring about nuclear transformations in Al, Cu, Rh, Ag, Cd, In, Sn, Au and Pb by X-rays from a W anticathode irradiated at 390 kV, and 5 mA current, but in no case could any nuclear effect be detected. This is in disagreement with the results of Trumpy (*Bergens Museums Arbok*, 1943), and reasons for this discrepancy are discussed. The rediffusion coefficient in the irradiation of Be, C, Al, Ca, Cu, Mo, Sn, W and Pb with electrons in the energy range 50–370 kV has been determined. The half-life period of the natural β-radiation from Rb^{87} was determined with the aid of the specially constructed Geiger–Müller tube, the value obtained being $(5{\cdot}8 \pm 1{\cdot}0) \times 10^{10}$ years. Using this value in conjunction with the determination of the Sr and Rb content of a Veruträsk pegmatite, the age of the mineral was found to be $(1\,740 \pm 520) \times 10^6$ years. A. J. M.

539.172.4 155

Probability problems in nuclear chemistry. SCHRÖDINGER, E. *Proc. R. Irish Acad. A*, **51** (*No.* 1) 1–8 (1945).—The problems relate to nuclear reactions. A neutron may or may not be effective in causing the fission of a nucleus. It will not be effective if it escapes from the reacting body or is caught in a non-splitting hit by a nucleus. The probability, η, that a neutron will be removed in one of these ways is calculated. The first theory is approximate and elementary. But the chance, $1 - \eta$, of a neutron making a splitting collision depends markedly on where the neutron is produced. When this is taken into account, an integral equation is obtained for the determination of η. This may be solved in certain cases. L. S. G.

539.172.4 156

On the disintegration of nitrogen by fast neutrons. BARSCHALL, H. H., AND BATTAT, M. E. *Phys. Rev.*, **70**, 245–8 (*Sept.* 1 *and* 15, 1946).—The cross-sections of the $N(n, p)C$ and $N(n, \alpha)B$ reactions were measured for neutrons of energies between 0·2 and 1·7 eMV. Resonances were observed for neutron energies of 0·55, 0·70 and 1·45 eMV. A.

539.172.4 : 771.531.1–834 157

A new method of recording of particles of the type of uranium fragments by means of a photographic plate. PERFILOV, N. *J. Phys., USSR*, **10** (*No.* 1) 1–12 (1946).—The effect of treating the photographic plate before exposure with CrO_3, $K_3Fe(CN)_6$ and $KMnO_4$ was investigated. It was possible to remove the background formed by particle tracks without prejudicing the sensitivity of the emulsion for further particle recording. A method was developed for selecting, from a number of particle tracks, those due to particles of higher energy than α-particles. A developer was used of concentration sufficient to develop only the more strongly excited grains of the latent image, leaving those excited by the α-particles unaffected. The method was applied to U-fission fragments produced by neutrons. A.

539.185 = 4 158

Collisions between fast neutrons and nuclei of any mass. LANGEVIN, P. *Ann. Phys., Paris*, **17**, 303–17 (*June–July–Aug.*, 1942) *In French.*—A neutron of energy E, in making a series of collisions with nuclei of a given mass, loses energy at each collision and so, during its passage through the material, its energy has a number of discrete values. The author calculates the probability, on purely classical grounds, that one such energy value shall fall within a certain prescribed range. Such a result finds application in the resonance capture of neutrons. W. E. D.

539.185 = 4 159

Effect of temperature on neutron-proton scattering. GIBERT, A., AND ROSSEL, J. *Helv. Phys. Acta*, **19** (*No.* 4) 285–306 (1946) *In French.*—An appreciable temperature effect is found for the scattering cross-section, σ, of slow neutrons by H_2 gas, and in the low temperature region, at least, it is in agreement with the theory of Sachs and Teller. The value of σ for H_2 at 300°K is found to be $(31{\cdot}6 \pm 0{\cdot}6) \times 10^{-24}$ cm², in agreement with determinations of other workers. The value $(19{\cdot}6 \pm 1{\cdot}4) \times 10^{-24}$ cm², for the scattering cross-section for slow neutrons by protons at rest also agrees with previous work. No definite evidence is found for the effect of the state of aggregation of hydrogen on the neutron scattering cross-section, but as the results cited for the liquid and gaseous states are not strictly comparable, arguments are put forward in support of such an effect. W. E. D.

539.185.7 160

Transmission of velocity-selected neutrons through magnetized iron. FRYER, E. M. *Phys. Rev.*, **70**, 235–44 (*Sept.* 1 *and* 15, 1946).—Using a neutron spectrometer [Abstr. 885 (1941)] the change in iron-neutron cross-section for completely saturated iron was measured for neutrons of de Broglie wavelength from $1{\cdot}3$ to $3{\cdot}0\times10^{-8}$ cm. The connection factor for incomplete saturation was determined from observations on $2{\cdot}37\times10^{-8}$ cm wavelength neutrons under different degrees of magnetization. As predicted by theory, the fractional change in transmission was found to increase with neutron wavelength, but the change was found to be 3 or 4 times > earlier measurements [Abstr. 1927 (1941), 2853 (1943)]. A.

STRUCTURE OF SOLIDS 539.2

539.23 : 532.612.3 = 4 161

On the structure of thin solid films. CABRERA, N. *C.R. Acad. Sci., Paris*, **222**, 950–2 (*April* 15, 1946) *In French.*—Metal films $< 1{\cdot}5\times10^{-6}$ cm thick examined by the electron microscope were found to be discontinuous, showing holes or being composed of separate grains. The free energies of a continuous film, a film with holes, and separate grains are estimated, and the stable form discussed as a function of film thickness and temperature. A. J. C. W.

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.373 162

Neumann bands and the planar-pressure theory of hydrogen embrittlement. ZAPFFE, C. A. *J. Iron Steel Inst.*, 8 *pp.* (*Advance copy, Aug.*, 1946).—In reviewing published work on Neumann bands, reason is found for disbelieving the present accepted theory that these bands represent primarily a twinning phenomenon. A fractographic study of Neumann bands in ingot Fe and in Si ferrite confirms this doubt. A new theory is offered based upon the role of visible planar imperfections seen in fractographs. To test the theory, the passage of H_2 gas through these irons is studied both before and after deformation by observing the effusion of the gas under oil. The observations provide proof that not only Neumann bands but also slip lines are based on and located by a pre-existent "planar imperfection structure." The sudden appearance of the H_2 bubble, its constant size, and its confinement to bands and slip markings, simultaneously afford proof for the fissured structure of these bands and for the planar-pressure theory of H_2 embrittlement. It is concluded that deformation bands in general comprise primarily a shearing movement of adjoining mosaic sections, and that the material within the zone of shear has a mathematical probability for twinning which varies from approx. $1{\cdot}0$ in metals such as Bi and Zn to 0 for certain other metals. In spite of the unlikelihood of twinning in body-centred-cubic structures, α Fe is known definitely to twin under certain conditions. A.

539.4.011.25 163

Extension of Griffith's theory of rupture to three dimensions. SACK, R. A. *Proc. Phys. Soc., Lond.*, **58**, 729–36 (*Nov.*, 1946).—Griffith's theory is extended to materials containing circular cracks. It is found that (*a*) the tensile strength of brittle material in one direction is not affected by stresses at right angles to it; (*b*) the result differs from Griffith's by a factor depending on Poisson's ratio of the material and lying between $1{\cdot}57$ and $1{\cdot}81$. A.

539.4.015 164

The mechanical properties of metallic solid solutions. NABARRO, F. R. N. *Proc. Phys. Soc., Lond.*, **58**, 669–76 (*Nov.*, 1946).—The theoretical relation [Abstr. 619 (1940)] between the lattice strains produced by precipitation in a metal and the corresponding increase in hardness is extended to the case of lattice strains in metallic solid solutions. The elastic limit of a single crystal of a solid solution is calculated on the assumption that the crystal will slip when the applied external stress is equal to the mean value of the internal stress. This mean is taken over the length of a dislocation, assumed to be 1 000 atoms. The estimate agrees in order of magnitude with the experimental observations. Similar considerations are applied to the hardness of polycrystalline solid solutions. The theory is extended to cases in which the increase of hardness produced by alloying is not large in comparison with the hardness of the pure solvent. A.

539.4.016 : 539.531 = 82 165

Influence of annealing on the hardness of tempered steel. MOROZ, L. S. *J. Tech. Phys., USSR*, **16** (*No.* 2) 171–80 (1946) *In Russian.*—The effect of annealing temperature on hardness is found to be not due to the disperseness of the carbides, as is usually thought, but to the hardness of the α-phase. D. S.

539.42 166

The behaviour of glass under impact and static loading. HAWARD, R. N. *Phil. Mag.*, **36**, 777–98 (*Nov.*, 1945).—Experiments were made on the strength of glass beams and plates; the beams being tested by slow loading and by the impact of a pendulum, and the squares both by pressing a steel ball against the square and by the impact of a falling ball. In the case of slow impact, using objects much heavier than the glass, the energy required to break the glass is greater than that needed under static conditions. This is explained by considering the time changes in the modulus of rupture of the glass. But as the velocity of impact is increased the energy required to shatter a glass plate diminishes rapidly. When glass is broken by small balls at high velocities characteristic cone or "shell" fractures are produced, and these seem to be an extension of the statically formed ring cracks along lines perpendicular to the maximum tension in the glass. Photographs of actual fractures are given. L. S. G.

539.501 : 532.5.032 = 82 *see Abstr.* 35

539.531 : 539.4.016 = 82 *see Abstr.* 165

539.56 : 669.71 = 4 167

On the brittleness of aluminium after casting. JOLIVET, H., AND ARMAND, M. *C.R. Acad. Sci.*,

Paris, **222**, 946–8 (*April* 15, 1946) *In French.*—Castings of pure Al are brittle and break if bent through 90° before they have cooled below about 630°C. If the metal contains a few tenths % of Fe and Si the brittleness extends to 580° on rapid cooling or 630° on slow cooling, and for the further range to 570° or 620° the castings crack without complete breakage. Castings cooled rapidly to room temperature and reheated are not brittle below 620°. Micrographic examination shows Al_3Fe after slow cooling, Al_4FeSi_2 ("Chinese writing") after rapid, and the greater range of brittleness on rapid cooling is attributed to the presence of liquid ternary eutectic. A. J. C. W.

539.893 : 536.48 *see Abstr.* 104

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.123.2 : 669.15 168

The equilibrium diagrams of certain alloys of iron. HUME-ROTHERY, W., AND CHRISTIAN, J. W. *Phil. Mag.*, **36**, 835–42 (*Dec.*, 1945).—The equilibrium diagrams of the systems Fe–Ti, Fe–V, Fe–Cr, Fe–Mn, Fe–Co and Fe–Ni are drawn and discussed. In the Fe–Ti system the size factor is unfavourable and the solid solution of Ti in Fe is restricted, while the liquidus and solidus curves fall steeply. In the system Fe–V the atomic diameters differ by 6% so that both the size factor and the electronic factor are more favourable. This means that the depressions of the liquidus and solidus curves are much smaller than in the system Fe–Ti. In the system Fe–Cr this is even more pronounced. In the case of Fe–Mn the difference in the crystal structure of the 2 metals prevents the formation of a continuous series of solid solutions. Various other aspects of the diagrams are discussed, and the form of these diagrams can be understood if the existing theories of alloy structure are united with the ideas of Pauling [Abstr. 385 (1939)]. L. S. G.

ELECTROCHEMISTRY 541.13

541.132 : 532.13 *see Abstr.* 33

541.132 : 532.133 = 4 169

Viscosity of solutions of salts. SUTRA, G. *C.R. Acad. Sci., Paris*, **222**, 875–7 (*April* 8, 1946) *In French.*—The equation of Darmois for the viscosity, η, of solutions of salts is of the form $(\eta - \eta_0)/\eta_0 = AC^{\frac{1}{2}} + BC + \ldots$, where η_0 is the viscosity of H_2O, A, B, etc., are constants, and C is the molar concentration of the solution. $B = 0{\cdot}0015\,v$, where v is the volume of the ions (in Å^3) given by one molecule of the salt. This is in general agreement with experiment, but there are discrepancies for $MgSO_4$, $MnSO_4$ and $CdSO_4$. It is shown that the disagreement is due to the fact that these electrolytes, supposed to be strong, are far from being completely dissociated in 0·0005M solution. In fact they may even be associated in solutions of this concentration. A. J. M.

541.133 : 534.321.9 *see Abstr.* 56

541.135.2 = 4 170

Mechanism of electrolysis. Study of energy-transfer coefficients. BONNEMAY, M. *C.R. Acad. Sci., Paris*, **222**, 793–5 (*April* 1, 1946) *In French.*—A consideration of the curves relating energy and potential difference allows complete account to be taken of the shape of the experimental over-voltage curves; whereas the Audubert formula, relating current density and over-voltage, accounts only for the first part of the curves. N. M. B.

ADSORPTION 541.183

541.183.1 : 531.19 171

On the approximate partition function in the statistical theory of adsorption. YING, C. F. *Chin. J. Phys.*, **6**, 1–16 (*July*, 1945).—In Bethe's theory of the adsorption of gas particles the partition function for the whole assembly is not calculated. But this function is necessary for such problems as the critical condensation phenomenon. In some unpublished work Wang developed a method for the approximate evalution of the partition function but this suffers from two defects: (1) heavy numerical work is involved; (2) in the special case of neighbour interaction the conclusion reached is that the condition of mathematical consistency is always satisfied, so that a partition function always exists; this is not true in general. Two modifications of Wang's theory are now suggested: (1) the expression for the configurational energy of the adsorbed layer is altered; (2) the statistical weight of the central site is altered. In each case the configurational partition function is evaluated and the adsorption isotherm and the heat of adsorption are computed for the case of a quadratic lattice with dipole interaction. The second method is better and is compared with Kirkwood's method [Abstr. 928 (1938)] in the case of a hexagonal lattice with neighbour interaction. L. S. G.

541.183.56.08 = 5 172

An apparatus for the measurement of adsorption and for gaseous reactions. AGLIARDI, A. *Ric. Sci. Ricostruz.*, **16**, 278–81 (*March–April*, 1946) *In Italian.*—An apparatus for the precision measurement of gas adsorption on solids is described, with diagram. It is all of Pyrex glass, except for the reaction bulb of Jena glass. One half of the apparatus serves for the preparation and purification of the reacting gases, and the other half for the circulation of the gases and the determination of the products of adsorption and of reaction. Measurements can be made at pressures between 1 200 and 0·001 mm Hg and at temperatures between −180 and 450°C. S. W.

CHEMICAL STRUCTURE 541.4/.6

541.67 : 538.22 = 82 *see Abstr.* 138

CHEMICAL APPARATUS 542.1/.7

542.26 173

Laboratory preparation of thin-walled plastic capillaries. NESS, R. K. *Rev. Sci. Instrum.*, **17**, 344 (*Sept.*, 1946).

CHEMICAL ANALYSIS 543/545

545.822 174

A method of quantitative spectrochemical analysis based on line widths. COHEUR, P. *J. Opt. Soc. Amer.*, **36**, 498–500 (*Sept.*, 1946).—Instead of comparing the intensity of a line with that of the internal standard, the width of the standard line is measured at an intensity value corresponding to the maximum of the unknown line. The method is practical and accurate, and is independent of development conditions or exposure time. A.

545.822 : 535.338.35 : 536.55 : 535.33.03 *see Abstr.* 70

CRYSTALLOGRAPHY 548

548.0 : [536.413 + 536.613 + 536.75] : 532.7 175

Volume, internal energy, and entropy of amorphous and crystalline selenium. BORELIUS, G., AND PAULSON, K. A. *Ark. Mat. Astr. Fys.*, **33 A** (*No.* 1) *Paper* 7, 16 *pp.* (1946).—The thermal expansion of glassy, spherulitic (crystallized at 75°C) and polycrystalline (crystallized at 215°C) Se (99·99%) were measured for the temperature ranges −78° to 34°, 55° to 95°, and −78° to 219°C respectively. The heat capacity of crystalline Se was measured in the range 180° to 220°C. A slight pre-melting increase in C_p is attributed to impurities; the melting point was found to be 221°C. The results were combined with those of previous workers to give the atomic volumes (graph) and the internal energies and entropies (tables) for the range 0° to 600°K. The differences between these properties for crystalline and amorphous Se are expected to throw light on the structure of the liquid state. A. J. C. W.

548.0 : 537.226.8 = 4 *see Abstr.* 112

548.0 : 538.614 = 3 *see Abstr.* 143

548.51 176

Cleavage of selenite and mosaic structure. TOLANSKY, S., AND KHAMSAVI, A. *Nature, Lond.*, **158**, 519 (*Oct.* 12, 1946).—Examination of the cleavage plane of selenite by means of multiple-beam Fizean fringes revealed that the surface was made up of narrow strips varying in size between 0·03×0·3 mm and less than 0·005×0·05 mm, and of height varying in steps which are multiples of the selenite lattice spacing, 15 Å. The suggestion is made that these strips represent the mosaic structure of the crystal.

548.52 = 4 177

Peculiarities of crystallization in ammonium chloride. DEVAUX, H. *C.R. Acad. Sci., Paris*, **222**, 1022–5 (*April* 29, 1946) *In French.*—Ammonium chloride crystallizes from a saturated solution in the form of dendrites with branches at right angles to one another, but the crystals show no plane faces. The branches continually increase and decrease in size, and occasionally "drops" become detached, as if the crystal were a viscous liquid. After some months most of the branches have disappeared, and the crystals show some attempt at interfacial angles, though plane faces never develop. A. J. C. W.

548.53 = 4 178

Production and disruption of guided orientations in the parallel growth of ammonium nitrate on muscovite mica. HOCART, R., AND MATHIEU-SICAUD, A. *C.R. Acad. Sci., Paris*, **222**, 966–7 (*April* 15, 1946) *In French.*—Ammonium nitrate deposits on muscovite in crystals of phase I, two orientations being observed [*C.R. Acad. Sci., Paris*, **221**, 237 (1945)]. Phases II, III, IV formed in succession on cooling preserve these orientations, but if IV is recrystallized three orientations are observed, which persist on reconversion to III. The occurrence of two only of the three with I is attributed to a better fit of the lattices in these orientations, and the guiding action of the original orientation during phase change explains the non-appearance of the third in III, for which it is a possible orientation. A. J. C. W.

METEOROLOGY 551.5

551.506 : 621.396.1 179

Measurements of refractive index gradient. WESTWATER, F. L. *J. Instn Elect. Engrs, Pt IIIA*, **93** (*No.* 1) 100–1 (1946).—A brief account of measurements of air temperature and humidity made over the Irish Sea in order to obtain correlation with radio propagation data.

551.594.13 : 537.311.37 : 537.568 *see Abstr.* 131

623.54 : 534.222.2 = 3 *see Abstr.* 51

669.018 : 621.318.323.2 : 621.317.4 : 538.245 = 4 *see Abstr.* 140

669.15 : 541.123.2 *see Abstr.* 168

669.71 : 539.56 = 4 *see Abstr.* 167

771.531.1–834 : 539.172.4 *see Abstr.* 157